State of Connecticut

State Geological and Natural History Survey

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GUIDE

TO THE

INSECTS OF CONNECTICUT

PART VI.

THE DIPTERA OR TRUE FLIES OF CONNECTICUT

First Fascicle

External Morphology; Key to Families; Tanyderidae, Ptychopteridae, Trichoceridae, Anisopodidae, Tipulidae.

By

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With an introduction by
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THE DIPTERA OR TRUE FLIES OF CONNECTICUT

Introduction

The Diptera, or true flies, constitute an important order of insects which are rather easily distinguished as a group from the other orders but which nevertheless exhibit a considerable diversity of structure, habits, and habitat. Their numbers may be very great under certain conditions, and their economic importance is significant. An adult fly possesses typically but one pair of well-developed wings, the posterior wings being degenerate, club-shaped organs called halteres. The mouth parts are adapted for sucking liquid food and in many species form a piercing apparatus. The larvae are legless maggots which may or may not have a well-defined head. The species found in Connecticut vary in size, as adults, from minute midges scarcely a millimeter long to relatively large species of crane-flies, horse-flies, and robber flies, which may measure 25 or 30 millimeters in length.

There are many different species of flies in the state, and some of these may be extraordinarily abundant at certain times of the year. The "Check-List of the Insects of Connecticut" (1) published in 1920, contains 1,111 species and varieties, which are definitely recorded up to that date, and the first supplement, published in 1938, contains an additional 454, but this does not include all the forms which doubtless occur here. The "Diptera of New England" (2) lists 3,304 species, and the "List of the Insects of New York" (3) contains 3,615 species. It may be safely assumed that close to 3,000 species of flies occur in Connecticut.

The abundance of flies, when suitable breeding places are available, may be very great. The surfaces of stagnant pools on salt marshes sometimes appear blackened with thousands of mosquito larvae. Matheson (4) estimated that over 100,000 adult females of *Culex pipiens*, the house mosquito, hibernated in a cellar 4′ x 6′ x 7′ in dimensions. Dr. Deevy, of Yale University, found 42,000 Corethra larvae per square meter on the bottom of a pond in Branford. In 1935 a swarm of *Atherix variegata*, a rhagionid fly, emerged from the Housatonic River at Cornwall (5). The females laid their eggs on the under side of two bridges over the river. One spot about 50 square feet in area was completely covered with eggs, and the supporting timbers of one of the bridges were encrusted with a deposit of eggs and dead flies one-half inch thick. Houseflies breed extensively in manure piles. Herms (6) has published an estimate, based on samples of a 1000-pound horse-manure pile exposed only four days

to adult flies, of a total of 450,000 larvae, or 900,000 per ton. This particular manure pile was only one of several in the city. Other species of flies, not so commonly noticed, may be quite abundant. An examination of wild flowers in any field in Connecticut on a warm summer day will reveal many syrphid flies hovering around and alighting on the blossoms, and crane-flies are often abundant in moist woodland areas.

The habitats of adult flies are usually limited to areas adjacent to favorable breeding places, although under certain conditions they may fly or be blown by winds some distance away. The presence of swarms of midges, numerous mosquitoes, or an abundance of house-flies, usually indicates that breeding has taken place in the vicinity. This is particularly important in the control of species of economic significance. In any discussion of habitat, then, it is the larval habitat that is more important. The variety of places in which these insects breed and their flying ability accounts for their presence in all parts of the state.

Although the requirements of fly larvae are diverse, for the majority of species a moist environment is essential. Many species are aquatic, living in ponds, pools, or streams. The volume of water necessary need not be large. The reservoirs of pitcher plants serve as the breeding place for some. Others occur in the water in cavities in trees. The imprints of cattle hoofs in low pastures frequently serve as breeding places for mosquitoes, and temporary pools on the salt marshes are notorious in this respect. Some species, as our black-flies and net-winged midges, live only in rapidly running streams. In large ponds and lakes the species which breed in the small shallow marginal pools may differ from those found in deep water, and certain types of lakes may have distinctive bottom-dwelling species. Some fly larvae, as rat-tailed maggots of the genus Eristalis, prefer water containing a great amount of decomposing organic matter and live in filth.

The larvae of many species live in soil or decaying organic matter of varying water content. Some horse-fly and crane-fly larvae live in mud, and other species are found in rotton stumps and logs. The larvae of some muscids and stratiomyids breed in privies. The soil of woodlands, pastures, and cultivated fields is a common habitat of larvae which feed upon dead organic matter, the roots of plants, or small soil-dwelling animals. Even ant nests are inhabited by a few species.

The living parts of plants above ground have their fly fauna, although these species may not be feeding on the plants themselves. Leaves of herbaceous and woody plants, stalks of herbaceous plants, and the cambium layer of trees have their mining and boring maggots. Fruits are infested with fruit fly larvae. A large number of species live in mushrooms. Many larvae which live in the leaves, stems and flowers of plants cause galls to develop. Syrphid fly larvae crawl about on the stems and leaves and feed on the aphids found there.

Aside from the habit of feeding on cadavers, a characteristic of blow-flies, there are many species of Diptera which parasitize living warm and cold-blooded animals. Spiders form the sole hosts of one family of flies, the Cyrtidae, and some other species are found in spider cocoons where they prey upon the eggs. Some phorid larvae live in the heads of ants. Almost all insect orders contain some species which are the prey of certain flies. The Tachinidae are noted as parasites of caterpillars and sawfly larvae. Rodents, ungulates, bats, and birds serve as hosts for internal and external parasites. Some of these parasites live as maggots in the intestinal tract, nasal passages, or flesh of mammals, and are known as bot-flies and warbles. The larvae of Protocalliphora live on nestling birds. Adult pupiparous flies live as external parasites on sheep, bats and birds.

The life cycle of the Diptera involves a complete metamorphosis, that is, the immature stages differ markedly from the adults and a transitional more or less quiescent stage, the pupa, intervenes between the two. During this stage a transformation occurs, the larval structures disappear, and the adult structures are formed. There are thus four stages in the typical life cycle of a fly—egg, larva (usually called a maggot), pupa, and adult. These four stages may occur in different places. Warble flies show a great diversity in this respect. The eggs are laid on the hair of the legs of cattle, the larvae spend the last part of their lives under the skin of the back, and the pupae are found in the soil. Even in the case of the housefly, which may spend its entire existence in and around a manure pile, the different stages of the life cycle occur in different parts of the pile. The eggs are laid on or close to the surface, the larvae live in the wet parts, the pupae are found in the drier sections or in the earth about the pile, and the adults hover in the air above. The northern house mosquito is more restricted in its habitat. The eggs are laid on the surface of the water and the larvae and pupae live in it. Among the pupiparous flies, such as the sheep tick and bird flies, the habitat is confined to the body of the host. The larvae are retained within the abdomen of the adult female until fully grown and the pupae adhere to the wool or feathers.

The abundance of flies depends, as does the abundance of any animal, on the reproductive power of the species and on the pressure of the environment which restricts its realization. The reproductive power is limited by the number of females present, the number of progeny per female, and the number of generations a year. Most species reproduce bisexually, so that an average population includes an equal number of males and females. A notable exception occurs in the case of certain cecidomyids, as Miastor, which reproduce in the larval stage, a phenomenon known as paedogenesis. Paedogenesis is not continuous, however, but is interrupted by a generation which reproduces bisexually. Most adult flies deposit eggs, but many species of the family Metopiidae produce young maggots, and the Pupipara produce fully grown maggots.

The number of eggs produced per female is often fairly large, but there is some correlation with the life cycle and habits. The crane-fly, *Eriocera longicornis*, lays about 950 eggs, and the house mosquito lays 100 to 400. The tachinid *Winthemia quadripustulata*, which oviposits on caterpillars, probably lays between 50 and 60 eggs at most, whereas *Sturmia scutellata*, which deposits its eggs on leaves where they are swallowed by feeding caterpillars, lays about 5,000. The common housefly lays its eggs in batches, and one female may deposit between 2,000 and 3,000 during its life. Pupiparous flies, in contrast to the above, have few progeny per female. The female sheep tick deposits 10 or 12 fully grown larvae singly at intervals of 7 or 8 days.

The eggs or larvae are as a rule deposited on or near the larval food supply. Thus blow-flies oviposit on carrion, houseflies in a manure heap, mosquitoes on the surface of pools or in depressions which will later be flooded, black-flies on rocks in flowing streams, and fruit flies in fruit. The females of species parasitic on other animals commonly lay their eggs on the body surface of the host. Most tachinids place their eggs on the integument of host insects, but some, as mentioned above, lay their eggs on leaves where leaf-feeding caterpillars can swallow them, and others deposit larvae inside caterpillars by slitting the integument with a larvipositor. Female warble flies lay their eggs on the hairs of the host, and horse-bots have a like habit. Predaceous species lay their eggs in the region where the prey of the larvae occur. Horse-fly larvae are predaceous on small invertebrate animals which they find in wet earth or in the water. The eggs are laid on vegetation or stones close to the larval habitat.

The period of incubation of most fly eggs is relatively short, although it may depend entirely on environmental conditions. Where the larval food supply is temporary, or the survival of the larva is otherwise endangered by a delay in hatching, a short incubation period is essential. High temperatures accelerate the incubation of eggs, and low temperatures prolong it. Dryness inhibits the hatching of the eggs of many species, but the larvae emerge quickly if moisture is supplied. The housefly egg hatches in 8 to 12 hours at 77° F. to 95° F., and in 2 or 3 days at 50° F. Blow-fly (Calliphora) eggs hatch in 6 to 48 hours. The minute eggs of leaf-ovipositing tachinids hatch within a very short time after getting into the intestines of caterpillars. The eggs of the apple maggot, which are laid in the fruit, have an incubation period of 5 to 10 days. Some species of mosquitoes have a long period of incubation of the eggs under certain conditions. *Aedes stimulans* deposits its eggs in dry woodland depressions in the summer, and these hatch when the areas are flooded the following spring. The eggs of *Aedes sollicitans* are deposited on the surface of a salt marsh where a pool has dried. Submergence with water after a few days in summer causes them to hatch, but it is said that hatching may not occur for three years if the marsh remains dry during the intervening summers. The eggs of species of *Psorophora*, a fresh-

water genus of mosquito, may remain dormant on the ground for months or even years.

The larval period of many flies is very short under favorable conditions, but that of some species is quite long. Temperature has an important effect, as larvae grow rapidly in warm weather, so one generation may have a longer developmental period than another. The larvae of the little vinegar fly, Drosophila, complete their development in 3 or 4 days in the laboratory. Mosquito larvae and housefly larvae develop in a very few days in the summer. The development of tachinids is generally correlated with the life cycle of the host, and the larval period may be days or months in length. Bot-fly and warble-fly maggots have a developmental period months in length. Some species of black-flies, crane-flies, and horse-flies hibernate as larvae.

The pupal period also shows much variation among species, and temperature again may be the determining factor in the variability within a species. Pupation may occur in the fall, and adult emergence in the spring. When hibernation occurs in the larval stage, the pupal period in the spring is relatively short. Species with many generations a year must obviously have a short pupal period during the summer.

The length of the life cycle, from egg to adult, is determined by both inherent and environmental factors, as is indicated by the remarks on the duration of the different stages. A warm summer may produce more generations of multivoltine species than one that is cool, and continued warm weather well into the fall may increase the number of generations. The occurrence of frequent rains during the summer may result in an increase in the number of generations of mosquitoes as compared with a drier season. Species that are inherently univoltine are not so markedly affected by temporary fluctuations in environmental factors during the summer, and the phenomenon of a single generation a year remains unaltered.

A considerable difference in size among individuals of the same species of fly is sometimes noticed. This is usually due to two factors, a sexual difference and a variation in food supply. The females of some species are larger than the males. If the food supply is not sufficient for normal growth, the larvae may mature, but the adults, although perfect in form, will be small.

Most species of flies exhibit a fairly obvious difference between sexes. This is found in the abdominal structures if nowhere else. The tip of the adbomen of the male is strikingly unlike that of the female, due to the development of external sexual organs. The male genitalia may be held partly withdrawn in the tip of the abdomen or they may be conspicuously exposed, as in crane-flies and many dolichopodids. In addition to this difference in genitalia, the antennae, eyes, and even wings of the sexes may show marked differences. The antennae of male mosquitoes and chironomids, for example, are much more hairy than those of females. The eyes of males of many species are closer together at the top of the head than are those of the

females. In some species the eyes of the males touch, a condition known as holoptic, while the eyes of the female remain separated, a dichoptic condition. This difference is not always found, for the eyes of both sexes may be widely separated in some species and may touch in others. The extreme of sexual dimorphism in wing structure is reached among flies of which the female sex is wingless and the males winged, as some Phoridae. The wings of the males of some mosquitoes are smaller and narrower than those of the females of the same species.

Flies are of great economic importance to the people of Connecticut, not being exceeded in this respect by any other group of insects. They are both deleterious and useful. Aside from their role in the mechanical and cyclical transmission of diseases of man and as irritating nuisances, they directly affect man's economy in several ways. It is not possible to go into great detail in the matter here, so a few illustrations will have to suffice.

Several species are of more or less value to man. The larvae of many aquatic crane-flies and midges serve as food for small fish. Adult syrphids pollinate flowers. Many species of muscoid flies feed on dead and decaying organic matter and can be considered useful in disposing of this material. The larvae of a great many flies are parasitic on other insects, and larvae or adults, or both, of other species are predaceous on insects. Whether or not such species are useful to man depends on what they attack. If the prey is deleterious to man, the parasite or predator may usually be considered beneficial. Robber-flies (Asilidae) are predaceous in both adult and larval stages, the adults capturing other insects, sometimes honey bees, on the wing and the larvae seeking their prey in the soil. The larvae of bee-flies (Bombyliidae) are parasitic on bees, wasps, grasshoppers, etc., and cyrtid larvae parasitize spiders. Adult dolichopodids capture and eat smaller insects, and larvae of many Syrphidae prey upon aphids. Our white grubs are parasitized by the larvae of the Pyrgotidae. The most important and best known family of parasitic flies is the Tachinidae. Their larvae live in the larvae or adults of many other species of insects, and some are very valuable in reducing the abundance of certain pests. Some tachinids attack a large number of different insects, and others are very restricted in their host relationships. One species commonly found in Connecticut, *Compsilura concinnata*, was brought to the United States from Europe to combat the gypsy moth. It attacks a number of different species of caterpillars. The very common little reddish tachinid, *Trichopoda pennipes*, confines itself mainly to the common squash bug. The army worm is heavily parasitized by flies of this family, and during an army worm outbreak, fly eggs can be seen on a large proportion of the caterpillars.

The use of flies in purely scientific investigations should be mentioned. The little red-eyed vinegar fly, Drosophila, is probably the most famous animal known to geneticists and has been the source of more information on heredity than any other species of animal.

Although flies have some good attributes, they are as a group undoubtedly much more detrimental than useful. Many species are disgusting nuisances, as cheese skippers and fruit maggots, which cause food to be rejected. However, if we consider for a moment the injury of some species to useful plants, the diseases of man transmitted by others, the parasites of domesticated animals, and the number of intolerable venomous biters included among these insects, we can obtain some conception of their economic importance.

Species injurious to useful plants are found in many families of Diptera. The crane-fly, *Nephrotoma ferruginea*, sometimes becomes a serious pest of young tobacco stands, eating the parts of the plant under ground. The gall midges of the family Cecidomyidae are frequently serious pests. The Hessian fly, although not of economic importance in Connecticut, has a bad reputation in wheat-growing regions of the country. The leaf-miner of boxwood also belongs in this group. The fruit flies of the family Trupaneidae include the apple maggot, *Rhagoletis pomonella*, two other species of the same genus which cause wormy cherries, and the leaf-miner of parsnip, *Acidia fratria*. The larvae of two species of the agromyzid genus Phytomyza mine the leaves of columbine, and species of the genus Agromyza mine the cambium of birch and maple trees, causing "pith flecks". The larvae of the Psilidae live in roots of plants and in galls, and one species, the carrot rust fly (*Psila rosae*), injures carrots. The family Muscidae has among its members four notorious species, the cabbage maggot (*Hylemyia brassicae*), the seed-corn maggot (*H. cilicrura*), the onion maggot (*H. antiqua*), and the spinach leaf-miner (*Pegomyia hyoscyami*). Even the Syrphidae, beneficial in many instances, include such pests as the bulb-flies (*Merodon*).

There are a great number of blood-sucking flies the adult females of which bite man and domesticated animals. Some of these are simply venomous biters, and they may be serious pests, but many also transmit diseases when they bite. The very small "no-see-ums", midges of the family Ceratopogonidae, often make life miserable near bodies of water in the summer. Both salt marsh and fresh-water mosquitoes are frequently iniquitous, and the species of Anopheles are the sole carriers of malaria. The horse-flies (Tabanidae) are notorious pests of live-stock, and members of the genus *Chrysops* often attack man. They may be implicated in the transmission of some diseases of horses and cattle in parts of the United States. Black-flies (Simuliidae) are also serious pests of man and domesticated animals by virtue of their poisonous biting. Among the Muscidae are two well-known pests of live-stock, the stable-fly (*Stomoxys calcitrans*) and the horn-fly (*Haematobia irritans*). Both sexes of these last two species suck blood.

Some fly larvae are important parasites of warm-blooded animals, a condition known as myiasis. The horse-bots (*Gasterophilus*) live in the stomach, throat, and nasal passages of horses. Cuterebrid larvae live under the skin of rabbits and squirrels, and the well-known ox warbles are larvae of Oestridae. Other oestrid larvae live in the

nasal sinuses of sheep. Nestling songbirds are sometimes killed by the larvae of Protocalliphora.

There is a group of flies, the Pupipara, which are parasitic as adults on birds, bats, and other animals. Some of these are wingless, and some have functional wings. The sheep tick is a well-known representative. Large birds are frequently infested with members of this group. These flies cannot survive long away from the host, and soon desert it if it dies.

Connecticut is an interesting collecting ground for students of insects. The northeastern and northwestern parts are in the Transition zone, and species indigenous to northern habitats should be found there if they occur anywhere in the state. The southern part and the Connecticut River Valley are in the Upper-Austral zone and the climate is warmer. The presence of salt marshes along the shore, a broad river valley cutting through the center, and wooded hills and valleys, lakes and streams, each side of this river give a variety of natural conditions with a consequent variety in the fauna. It is obviously absurd to claim that any one species of Diptera is confined to the limits of such a relatively small region as Connecticut which is neither unique in its natural characteristics nor isolated. In this work all of the species which are likely to be found in the state are included.

The Diptera of Connecticut is a compilation by several authors who have used the sources of information available to them. Each is a specialist on that section of the work which bears his name. This has led to some lack of uniformity in the terminology, but each section is a complete unit and is accompanied by explanatory text figures, so no confusion should result.

In any phase of entomological work, be it economic or otherwise, the correct identification of the species concerned is the first essential. This is the major purpose of the present work. The localities in which the species occurs and the frequency with which it is found are also important. This information, along with some of a relevant nature, will be found in the following pages. The classification of such a large group of animals as the Diptera is never in a completely satisfactory state, and the interrelations of families and genera can only be expressed as the view of the author. However, the statement has been made to the effect that the important point is the correct determination of the species, for God made that, and families and genera are purely human conceptions and hence of less significance.

This first part of the Diptera of Connecticut contains a section on comparative morphology, the key to the families and a section on the primitive tipuloid flies. Other sections will follow. A separate bibliography of the more important literature accompanies each section.

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The External Morphology of the Diptera

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Variations in Size

It has been said that if all of the species of the animal kingdom were arranged in an ascending series from the smallest protozoön to the largest whale, a common housefly would be seen to be of average size, and from this standpoint the average dipteran is not unduly small, but most members of the order Diptera are of moderate size, and do not, as a rule, exhibit wide variations in size within a single family.

Williston (1908) states that the largest dipteran observed by him was a Brazilian species of *Mydas* which measured 52 mm. in length, while the smallest fly observed by him was a cecidomyid measuring less than half a millimeter in length (the antennae were not included in these measurements); and, as he points out, the *Mydas* fly was more than a million times the size of the cecidomyid. Williston further states that "In no single family of Diptera are the differences in size anywhere nearly so great as those between the mydaid and cecidomyid. Seldom do the differences in linear measurements in any one family exceed ten fold."

Perhaps the greatest wing expanse to be found in any dipteran occurs in the Burmese tipulid, *Ctenacroscelis rex*, which measures over 100 mm. from tip to tip of the expanded wings, while the North American tipulid, *Dasymolophilus ursinus*, has a wing expanse of a little more than 4 mm. The former is more than a thousand times the size of the latter, and this difference in size is perhaps the greatest to be found within the limits of a single family, although the linear measurements of the two tipulids would not bring out this fact, since the forms in question are extremely elongated and slender.

The largest and bulkiest representatives of the order are to be found in the orthorrhaphous brachyceran families Tabanidae, Pantophthalmidae, Asilidae, Mydaidae and Cyrtidae, and in the cyclorrhaphous family Syrphidae, while the smallest Diptera are to be found in the nematocerous families Ceratopogonidae and Cecidomyidae.

Variations in Form and Structure

As a rule the Diptera are rather conservative in form, but wide departures from the typical body habitus do occur among them, as

*The writer wishes to make use of this opportunity of expressing his sincere thanks to Drs. C. P. Alexander and C. H. Curran for identifying the insects here figured, and for many valuable suggestions during the preparation of this chapter, to Dr. Philip Levereault for making many of the accompanying drawings, and to Dr. Inez Williams for assembling many of the drawings and labeling the figures.

may be seen by comparing the broad, greatly flattened body of a nycteribiid, streblid, or hippoboscid, with the markedly compressed body of certain mycetophilids, or by comparing the compact thickset body of a cyrtid with the extremely slender elongated body of a tipulid of the genus *Tanypremna*, which apparently includes the slenderest species of Diptera. The somewhat slender type of body characteristic of most Nematocera is evidently the primitive one, while the more robust type of body is encountered in the higher Diptera.

Variations in the structure of the head, thorax and abdomen will be described under the detailed discussions of these regions of the body, but since the modifications of the wings are not discussed under these headings, it may be of interest to point out some of the modificational extremes occurring in the development of the wings. In the remarkably aberrant nematocerous fly, *Nymphomyia alba*, recently described by Tokunaga (1932b)—shown in Plate 34 of Vol. 13, Annotationes Zool. Japonenses—the wings are extremely long and slender and are bordered with very long hairs to compensate for the loss of wing surface necessary for flight. In the peculiar anthomyid, *Exul singularis*, on the other hand (see Plate 2 of the "Insects of Australia and New Zealand" by Tillyard, 1926), the wings are enormously expanded, and their breadth almost equals their length in this peculiar fly. In the asilid, *Eurhabdus zephyrea*, shown in Fig. 140, p. 182 of the "North American Diptera" by Curran (1934), the basal half of the wing is narrowed to form a long slender petiole, while in the helomyzid *Criddleria hemiptera*, shown in Fig. 16, p. 381 of the same book, the distal two-thirds of the wing becomes drawn out into a long slender process.

The wings are usually well developed in the tipulids, but they are vestigial in the tipulid *Chionea* which lives on the snow, and both wings and halteres have completely disappeared in the tipulid *Limnophila (Roraimomyia) permonstrata*, although the halteres are usually retained when the wings are lost. Comstock (1924), in his "Introduction to Entomology," p. 793, states that both wings and halteres are absent in the mycetophilid *Pnyxia* (female), and also lists the Chironomidae, Phoridae, Borboridae, Ephydridae, Nycteribiidae, Hippoboscidae and Braulidae, as the families in which the wings may be vestigial or wanting. A more nearly complete list is given by Brues and Melander (1932, p. 347-352), who likewise include the Cecidomyidae, Scatopsidae, Chiromyzidae, Termitoxenidae, Thaumatotoxenidae, Empidae, Dolichopodidae, Ephydridae, Drosophilidae, Dryomyzidae, Caelopidae, Anthomyidae, Micropezidae, Chloropsidae, Streblidae, etc., as the families in which wingless forms, or those with vestigial wings, may occur.

No comprehensive studies of the entire external morphology of the Diptera in general are available at the present time, although Hendel (1928) has discussed many characters of taxonomic importance in the Diptera, and Walton (1909) describes the head and thoracic structures of the higher Cyclorrhapha in connection with the chaetotaxy of these parts (see also the morphological sections of Townsend's "Manual of Myology"), while figures of the heads, wings, etc., of var-

ious Diptera are to be found in the general treatises of Lundbeck (1907-1927), Verrall (1901-1909), Williston (1908), Curran (1934), Brues and Melander (1932), and others. Textbooks of medical entomology, such as that of Patton and Cragg (1913), (recently revised by Patton and Evans, 1929), frequently contain figures of the structures of the Diptera which are involved in the spread of disease: and the mouth parts of certain Diptera are described in many of the recent textbooks of entomology, such as that of Weber (1933), Metcalf and Flint (1932), Snodgrass (1935), etc., while the wings of most of the dipterous families are figured in Comstock's "Introduction to Entomology," but the other parts of the body are either omitted, or are treated very briefly in these general works. (Many structures of Diptera are also figured in the recent work of Snodgrass, 1935.)

A few studies of the external morphology of individual species of Diptera have been published, and among those dealing with the external anatomy of individual Cyclorrhapha and Orthorrhapha Brachycera may be mentioned the works of Lowne (1890-1895) on *Calliphora* (two volumes), Hewitt (1914) on *Musca* (one volume), Parker (1914) on *Ravinia*, Worthley (1924) on *Trichopoda*, Seamans (1920) on *Anthomyia*, Kuenckel d'Herculais (1875-1881) on *Volucella* (two volumes), Bromley (1926) on *Tabanus*, and Cragg (1912) on *Haematopota*.

The external morphology of individual Nematocera is discussed in the papers by Tokunaga (1930) on *Limonia* (a very thorough study), Tokunaga (1932) on *Pontomyia*, Tokunaga (1935) on *Nymphomyia*, Williams (1933) on *Protoplasa* (including figures of the wings of all of the tanyderid genera), Crampton (1926) on a fossil *Macrochile*, Miall and Hammond (1900) on *Chironomus* (one volume), Christophers (1901) on a female mosquito, and Rees and Ferris (1939) on both sexes of *Tipula*.

Morphology of the Head and Its Appendages

The excellent general study of the head and the mouth parts of the Diptera by Peterson (1916) is by far the best work on the subject, although a different interpretation for some of the parts is suggested by Crampton (1925). The discussion of the dipterous head by de Meijere (1916) is quite comprehensive, and the descriptions by Snodgrass (1935), Curran (1934), Hendel (1928), Frey (1913-1921), Becher (1882) and Meinert (1882) are very valuable, as are also the studies of Dimmock (1881), Gruenberg (1907), Hansen (1884), Kellogg (1899), Menzbier (1880), Smith (1890), and Wesché (1904-1909), although the interpretations proposed by some of these investigators need revising.

Of the papers dealing with one or two types of Diptera, the fine series by Jobling (1926-1933) is worthy of especial mention, and the works of Cragg (1912-1913), Adler and Theodor (1926), Christophers, Shorrt and Barrand (1926), Frew (1923), Giles (1906), Graham-Smith (1930), Hammond (1874), Hansen (1903), Kraepelin (1883), Kulagin (1905), Leon (1924), Miall (1892), Minchin (1905), Mug-

genburg (1892), Patton and Evans (1929), Stevens and Newstead (1907), Stuhlmann (1907), Vogel (1921), and Wandolleck (1894) are of value for the study of various features of the heads of individual Diptera. Descriptions of the sclerites and vestiture of the heads of typical muscoidean flies are given in the publications of Wainwright (1928), Walton (1909), and Townsend (1908). Various types of antennae found in the Diptera are figured in the papers of Wandolleck (1894), Alexander (1919), Peterson (1916), Patton and MacGill (1925), and Curran (1934), etc.

1. Modifications of the head

In the diopsid genera *Sphyrocephala*, *Diopsina* and *Diopsis*, the lateral regions of the head which bear the eyes and antennae exhibit an increasing tendency to jut out on each side of the head until they finally develop into extraordinarily elongated eye-stalks bearing the eyes and antennae at their tips, as in the male diopsid *Teleopsis* shown in Fig. 3, B. In males of the otitid fly, *Richardia telescopica*, figured by Curran (1934, p. 20), the eyes are also borne at the ends of long eye-stalks, but the antennae remain in their normal position near the median region of the head.

In some species of the tipulid genus *Helius*, the head region below the eyes is moderately prolonged to form a short "rostrum" (bearing the reduced mouth parts at its tip) which in other species of *Helius* becomes half as long as the body, while in the genus *Elephantomyia* the rostrum may be half as long as the body, or it may greatly exceed the body in length (Fig. 3, A). A similar ventral prolongation of the head region below the eyes, bearing the mouth parts at its tip, occurs in the tipulid genus *Toxorhina* and in the tanyderid genus *Peringueyomyina*.

In mycetophilids of the *Gnoriste* type (Fig. 4, D), the region of the head extending along the anteclypeus, *ac*, is the principal one involved in the formation of the elongated rostrum or "proboscis", and the mouth parts, borne at its tip, remain small.

In the head of a female mosquito (Fig. 3, E), the labrum and mouth parts are the structures which become greatly elongated, and the head capsule itself is but slightly affected by the process. In this type, the elongation of the labium is effected by the lengthening of the prementum (*pm* of Fig. 3, E) while the labella, *la*, are not greatly elongated, as is also the case in the head of the cyrtid shown in Fig. 3, C.

In the type of head exhibited by the tipulid *Geranomyia* shown in Fig. 4, H, the parts which become extremely elongated are the labrum, *lr*, the hypopharynx, *hp*, and the labial palpi or labella, *la*, while the rest of the labium and other mouth parts are not greatly affected by the process. The labella are extremely long and slender in *Geranomyia*, but Edwards (1931) has described a chironomid, *Rhinocladius longirostris*, in which the labella are as long as the body, and the labella of this chironomid are probably longer than the labella of any other Diptera.

In the richardiine fly *Gnathoplasma infestans*, shown in Fig. 3, F, the region of the head just below each of the eyes becomes prolonged to form two horn-like projections which give the name "stag-flies" to these insects; and in the lauxaniine genus *Monocera* and similar forms figured by de Meijere (1916a), other projections of the anterior region of the head give it a very peculiar appearance in these insects.*

As might be expected, the heads of the Diptera which live as ectoparasites on bats and other hosts, are frequently greatly modified, along with the rest of the body, in adaptation to the parasitic mode of existence. Thus, in the nycteribiid shown in Fig. 7, B, the small, narrow, pyriform head is laid back in a groove of the thorax of this curious insect. The head of the streblid *Megistopoda* (or *Pterellipsis*) figured by Williston (1908, p. 384) is very irregular in shape, with protruding prominences which give it a most unusual appearance, while in other streblids, such as the one shown in Fig. 7, F and G, the head is greatly flattened dorso-ventrally, its surface is divided up into irregular patches, and it is bordered posteriorly by a ctenidium, or dense row of stout, backwardly-projecting, black bristles.

In the parasitic forms, there is a marked tendency toward a reduction of the compound eyes, while in such forms as the pipunculids, cyrtids, etc., the compound eyes occupy most of the area of the head capsule, and their development greatly affects the general appearance of the head. The eyes are usually dichoptic, or separated from each other, but in some Diptera they are holoptic, or contiguous, particularly in the male sex. When the eyes become approximated, they may meet above the bases of the antennae, and separate them widely from the ocelli, as in *Oncodes gibbosus* (Fig. 1, D), or the eyes may meet below the bases of the antennae, and leave the antennae in the neighborhood of the ocelli, as in *Acrocera globulus* (Fig. 1, E). Other modifications of the eyes which do not have such a pronounced effect upon the appearance of the head will be described in the more detailed discussion of these structures taken up later on.

2. External landmarks of the head capsule

Riley (1904) has very clearly shown that even in such a primitive insect as the roach *Blatta*, the segments of the head region of the embryo fuse so completely, to form the definitive head capsule of the adult insect, that the original segmentation can no longer be distinguished in the completed head capsule. The same is evidently true to an even greater extent in such highly specialized insects as the Diptera (in which the formation of the various head-sclerites has never been satisfactorily traced from the embryo to the adult stages) so that Hendel (1928), de Meijere (1916), and others who interpret various superficial markings on the head capsule of adult Diptera as the boundary lines between the original segments of the head, are hardly justified in so doing. Furthermore, many of the sutures and similar markings of the head capsule of adult Diptera do not correspond ex-

*In the phytalmiid fly *Phytalmodes* shown in Fig. 627 of the "Classification of Insects" by Brues and Melander (1932), the head has a very peculiar shape, with the reduced proboscis borne on the concave ventral portion of the broad head in which the genal regions beneath the eyes are prolonged downward on each side, to some extent.

actly to the primary sutures demarking the principal sclerites of the head in the orthopteroid insects, and are for the most part secondarily-formed lines, occurring only in the Diptera and their immediate relatives. It is therefore inadvisable to use these secondarily-formed lines for delimiting the primary sclerites of the head capsule in adult Diptera, and other structures must be relied upon for this purpose.

The principal landmarks of value for delimiting the sclerites and areas of the head capsule are the frontal or pretentorial pits, the points of attachment of the antennae, the median ocellus (when present) and the compound eyes.

The frontal or pretentorial pits (*fp* of Fig. 1, A, B, G and L, Fig. 3, D, etc.) which are the external apertures of the internal invaginations forming the anterior arms of the tentorium, demark the posterior limits of the clypeus and the anterior limits of the frons, while the median ocellus, when present, demarks the posterior extent of the frons. The median ocellus lies in the posterior angle of the frontal suture (demarking the posterior limits of the frons) in lower insects, and when the frontal suture is lost, as is the case in most Diptera, the median ocellus may remain, and in such cases serves to mark the position of the posterior angle of the frontal suture, which formerly marked the posterior extent of the frons.

Some dipterists mistake the ptilinal fissure (*ptc* of Fig. 4, J) for the frontal suture of lower insects. The ptilinal fissure, however, is formed by the infolding of the ptilinum, or eversible sac which is protruded to push open the top of the puparium when the fly emerges from its pupal case, and is therefore a wholly different structure from the frontal suture, formed by the arms of the inverted Y-shaped epicranial suture in lower insects (which have no ptilinum), so that the ptilinal suture cannot be used to delimit the frons posteriorly, as these dipterists maintain.

The points of attachment of the antennae may serve in a general way to divide the frons into a prefrons and a postfrons (*prf* and *pof* of Fig. 1, G and L), and they likewise serve to demark the posterior limits of the region called the face by Walton (1909), who defines the face as "that area of the head bounded by the base of the antennae, the oral margin eyes and cheeks."

The compound eyes divide the vertex into an anterior and posterior vertex (*av* and *pov* of Fig. 1, F) in the Tipulidae, and in certain holoptic Diptera, the contiguous compound eyes may demark the posterior boundary of the frontal triangle or the anterior boundary of the vertical triangle, as will be discussed later.

3. Sclerites of the head capsule

The labrum, *lr*, which probably represents a portion of the prostomium of the annelid ancestor of the Arthropoda, is morphologically a portion of the head capsule, while the mouth parts are modified limbs of the gnathal segments of the head, but since the labrum is functionally one of the mouth parts in the Diptera, it will be considered under the discussion of the mouth parts. The epipharynx is a modified por-

tion of the "inner" or posterior lining of the labrum, and since it is merely a modified portion of the labrum, it is not necessary to refer to the labrum of higher Diptera as the "labrum-epipharynx" as though it were a composite structure formed by the union of a distinct labrum and epipharynx. The posterior limits of the labrum may be marked by a clypeolabral suture, but in most insects the most constant landmark indicating the posterior limits of the labrum is furnished by the position of the tormae, or hinge-like thickenings (one on each side) at the base of the labrum, on the "inner" or posterior surface of the upper lip. The sclerites which are supposed to represent the tormae which have migrated to the anterior surface of the head capsule in certain Diptera, are probably secondary formations, like those occurring in the anteclypeal region of the orthopteroid insects, such as *Gryllotalpa*, *Syntermes*, etc.

The clypeus, *cl*, is the region between the labrum and the frons; and is demarked anteriorly by the tormae, while the posterior limits are demarked by the fronto-clypeal suture, or by a line drawn across from one frontal pit, *fp*, to the other (Fig. 1, G) when the fronto-clypeal suture is absent.

In orthopteroid insects such as *Gryllus*, *Syntermes*, etc., the clypeal region is divided into an anteclypeus and a postclypeus (or epistoma), and the sclerite labelled *ac* in the Diptera shown in Fig. 1, L, Fig. 4, A, B, E, J, etc., may possibly be a sclerite of the anteclypeal region* serving to support the fulcrum, *fu*, which is attached to it in such Diptera as the ones shown in Fig. 4, B, E, etc. Since the anteclypeus is merely an anterior region of the clypeus it is not entirely incorrect to refer to the sclerite *ac* as the "clypeus" (as is done by many dipterists), although it is more accurate to call it the anteclypeus. Hendel (1928) and de Meijere (1916a) call it the "prelabrum" (although it is postlabral in position), while Peterson (1916) calls it the "tormae" since he thinks that the tormae migrate to the anterior surface of the clypeal region to form the sclerite in question; but it is much more probable that the sclerite in question in the Diptera is formed by the distinct anteclypeal sclerites such as those found in some termites, mole crickets, and other orthopteroid insects described by Crampton (1932)—see Plate 4, Fig. 1, Plate 6, Fig. 20, etc.

The narrow marginal sclerite, *poc* of Fig. 1, B and L, Fig. 3, D, etc., corresponds in a general way to the sclerite called the postclypeus or epistoma in the orthopteroid insects, and in fact the designation epistoma is applied to the region *poc* of Fig. 4, J, by some dipterists, although the term epistoma may include a greater area than the postclypeal region according to other dipterists. Thus, Smith (1906) defines the epistoma in the Diptera as "that part of the face between the front and the labrum; the oral margin and an indefinite space immediately contiguous thereto and so equivalent to peristoma," and then defines the peristoma as "the border or the mouth or oral margin in Diptera; sometimes used as equivalent to epistoma." It is preferable to restrict the term epistoma to the postclypeal region, *poc*, in

*(In certain muscoids such as *Calliphora*, etc., an interclypeus, or sclerite between the anteclypeus and postclypeus, is formed just behind the anteclypeal sclerite.)

the Diptera (as is done in the lower insects), and the term peristoma may then be used to refer to the general "oral margin" or border of the "oral cavity". The cavity into which the base of the proboscis is retracted should be called the subcranial cavity and its margin should be called the subcranial margin, however, since the true oral cavity is a wholly different region in relation to the mouth parts, and it is therefore incorrect to refer to the cavity into which the base of the proboscis is withdrawn as the "oral cavity", or to refer to its margin as the "oral margin".

The frons or front (*mf* and *fv* of Fig. 4, J, etc.) extends from the fronto-clypeal suture (or from a line drawn across from one frontal pit to the other) to the frontal suture (formed by the arms of the Y-shaped epicranial suture) in the lower insects. In the Diptera, however, the true frontal suture, which contains the median ocellus in its posterior angle, is apparently absent, despite the fact that Peterson (1916) and others regard the ptilinal suture, *ptc* of the dipteran shown in Fig. 4, J, as the frontal suture in the higher Diptera, and interpret the fronto-clypeal suture, *fcs*, bordering the postclypeus or epistoma posteriorly in the Diptera shown in Fig. 1, H, etc., as the frontal suture in the lower Diptera. Some feature other than the frontal suture must therefore be used to demark the posterior limits of the frons in the Diptera, and on this account the position of the median ocellus has been accepted for this purpose, although it has also been suggested that the bases of the antennae would make ideal landmarks for delimiting the frons posteriorly were it not for the fact that the median ocellus is typically borne in the postero-median region of the frons in lower insects, and the region between the bases of the antennae and the median ocellus (i. e., *fv* of Fig. 4, J) must therefore also belong to the true frons in the Diptera. Walton (1909) limits the frons or front to the "space between the eyes in dichoptic flies, limited by the upper margin of the head and a line drawn through the root of the antennae," but if the frontal region of the Diptera is to be homologized with the frontal region of lower insects, it must also include the region *mf* below the antennae down as far as the frontal pits in both cases. Since some other designation should be used for the region called the front in Walton's definition of the frons of the higher Diptera, the term "postfacial area" has been suggested as a possible substitute.

The points of attachment of the antennae divide the frons into a preantennal region of the frons and a postantennal region of the frons (*prf* and *pof* of Fig. 1, G and L, etc.) to which the terms prefrons and postfrons might be applied, although the boundaries of these regions do not coincide quite exactly with those of the regions called the prefrons and postfrons by Hendel (1928) and de Meijere (1916), who have attempted to apply Berlese's terminology to the areas of the head in the Diptera.

The lunula, frontal lunule, or frontal crescent, is an oval or crescentic area, *lu* of Fig. 4, J, occupying the space between the bases of the antennae and the hinder angle of the ptilinal suture, *ptc*, in the Schizophora. Townsend (1908, p. 21) considers that the lunula is

formed as "an anterior chitinized portion of the sac or ptilinum," although the lunula may possibly bear some relation to the posterior area *po* of the Diptera shown in Fig. 1, L, J, etc.

The facies or face is the "area of the head bounded by the base of the antennae, the oral margin, eyes and cheeks" according to Walton (1909) who applies the designation mesofacial plate (Lowne, 1890) to that portion of the face enclosed by the ptilinal suture, *ptc*, and the vibrissal ridges, in such muscoidean flies as the one shown in Fig. 4, J. In the mesofacial plate are situated the vertical depressions or shallow grooves called the antennal foveae (also called the antennal fossae or grooves) in which the antennae rest. The lateral borders of these grooves are bounded by the facialia (Desvoidy, 1830) or vibrissal ridges (Hough, 1898), at the lower ends of which are two prominences (one on each side) called the vibrissal angles. In some flies a vertical median ridge, or facial carina, separates the antennal fossae.

The terms parafacials (Townsend, 1908) or parafacialia (Bezzi, 1925) are applied to the lateral areas of the face (labelled *pf* in Fig. 4, J) which are situated on each side of the mesofacial plate, and lie between the arms of the ptilinal suture, *ptc*, and the anterior borders of the eyes. These areas correspond in a general way to the areas called the facial orbits by Loew (1862) and are homologous with the lower portions, at least, of the regions called the parafrontal sclerites in lower insects. The designation "parafrontals", however, is usually restricted to the genovertical plates, *gv* (Fig. 4, J), in the Diptera, and it would create considerable confusion to apply the term parafrontal sclerites to the areas *pf*, which may therefore be referred to as the parafacial sclerites.

Wainwright (1928) misapplies the term "genae" to the parafacial areas, *pf* of Fig. 4, J, and Walton (1909) does the same, although he calls the true genae, *ge* of Fig. 4, J, the "cheeks", apparently not realizing that the terms genae and cheeks are synonymous. Verrall (1909) in criticizing Walton's application of these terms, states that the parafacials, *pf* of Fig. 4, J, should be called the "side cheeks" and refers to the true genae, *ge*, as the "jowls". Curran (1934) states that there is such a disconcerting confusion in the application of the designation genae in the Diptera that the term should be dropped, but the students of other orders of insects have always applied the designation genae to the region below (and also slightly behind) the compound eyes, corresponding to the area *ge* of the fly shown in Fig. 4, J, and there is no reason why the dipterists should not do the same, if they wish to bring their terminology into harmony with that employed by other entomologists. The designation "cheeks" should likewise be restricted to the region *ge*, since the terms genae and cheeks are synonymous.

Hendel (1928, p. 19) applies the designation malae to the genae, *ge* of Fig. 4, J, but the designation malae has always been applied to the lobes of the maxilla (i. e., to the galea or lacinia, or to both united) in coleopterous larvae and other insects, and there is no advantage in further increasing the confusion in anatomical terminology by applying the term malae to any other structures than the maxillary lobes.

The hairy, or setigerous, areas of the genae, lying below the transverse impression, or cheek groove, are called the buccae by Hough and other dipterists, and the designation "jowls" is usually applied to the same area (i. e., as a synonym of buccae). Wainwright (1928) applies Desvoidy's term lateralia to the buccae (or to the genae) and applies Desvoidy's term medianae to the upper region of the genae. Lundbeck (1927) applies the designation intermediate triangle to an area corresponding to the latter region (compare also the transverse impression) which corresponds in a general way to the inferior orbit of Loew's terminology.

Walton (1909) considers that the "genae" are continued upward toward the top of the head to form the areas *gv* (Fig. 4, J) to which Hough (1898) applied the designation genovertical plates. There is no objection to Hough's term for the areas in question, provided that it is understood that the true genae, *ge*, take no part in the formation of the genovertical plates. Lowne (1890) calls these areas the parafrontals (the parafrontalia of Bezzi, 1925), but they represent only the upper portions of the parafrontal areas of lower insects (since the parafacials of the Diptera represent the lower areas of the parafrontal sclerites of lower insects) and the designation parafrontals should not be restricted to the genovertical plates alone. Wainwright (1928) calls the genovertical plates the frontorbita (a modification of Loew's designation frontal orbits) and states that they have been referred to as the optica frontis by Desvoidy (1830), the orbites superiores by Pandellé (1888), etc.

The designations frontalia (Desvoidy, 1830) and frontal vitta (Loew, 1862) are applied to the region *fv* of Fig. 4, J, in the higher Diptera; and according to Wainwright (1928), this region corresponds to the area called the interorbite by Pandellé (1888). The frontal vitta is regarded as the median region of the "front" while the genovertical plates are regarded as the lateral areas of the "front" by Walton (1909), (who defines the front as "the space between the eyes in dichoptic flies; limited by the upper margin of the head and a line drawn through the root of the antennae"). The term front, however, is a synonym of frons, and the true frons extends downward below the antennae as far as the frontal pits (demarking the posterior limits of the postclypeus or epistoma), so that any attempt to limit the application of the term front to the area above the antennae is hardly justifiable.

Hendel (1928, p. 17) would include under "schizometopie" that condition of the upper region of the head of the Schizophora in which the membranous frontal vitta (which is still flexible in the freshly emerged fly) is limited to the median region alone; and on each side of it a continuous sclerotized strip, corresponding to the frontal orbit, extends along the border of the eye, and is continued ventrally, without a break, in the parafacial plate (as is the case in *Scatophaga*, *Mixocordylura*, etc.). Hendel regards as an intermediate stage the condition exhibited by *Tephritis*, in which the membranous area of the median frontal vitta extends laterally, on each side, and divides the frontal orbit into a dorsal portion and a lower portion (the latter be-

ing connected with the parafacial area). Finally, in the condition which he includes under "holometopie", the encroaching area of the frontal vitta obliterates the lower portion of each frontal orbit completely, and extends across from one eye to the other, as in *Suillia*, etc.

When the membranous area of the frontal vitta becomes more extensive, sclerotized areas of the head capsule may persist to form sclerotized strips or "interfrontal strips", which converge anteriorly, as in *Desmometopa*, *Collinella*, *Tethina*, etc. The large ocellar plates, or interfrontalia, which extend far forward between the frontalia in the Chloropidae (e. g., *Capnoptera*) are regarded as secondary formations by Hendel.

Hendel further states that whereas the coronal or sagittal suture bisects the region of the head bearing the ocelli in the Nematocera, in the Brachycera, on the other hand, what appear to be two branching arms, or posterior branches of this suture, demark an ocellar plate, or ocellar triangle, in which the ocelli are situated; and Hendel makes these designations synonymous with the interfrontalia of Desvoidy's terminology (i. e., the areas extending forward between the frontalia in some flies). Wainwright (1928) calls this area the ocellarium, and both he and Townsend (1908) state that Desvoidy refers to this area (i. e., the ocellar plate) as the "stemmata". It would appear, however, that Desvoidy probably applied the term stemmata to the ocelli themselves (since this term is frequently used for the ocelli) and according to Hendel, Desvoidy referred to the ocellar plate as the interfrontalia. The ocelli are sometimes borne on a raised area or tubercle called the ocellar prominence, to which Wainwright's term ocellarium might well be applied.

Wainwright (1928) states that Williston (1908) and Wingate (1906) refer to the ocellar triangle "as being on and surrounded by the vertical triangle," and Walton (1909) indicates that the ocellar triangle may be marked off in the vertical triangle by grooves, depressions or colorations, although most dipterists do not distinguish between the ocellar triangle and the vertical triangle. In some holoptic forms in which the ocelli are absent (e. g., in the males of certain Tabanidae, etc.) the term vertical triangle is more appropriate than the designation ocellar triangle for the triangular median area posterior to the contiguous portions of the eyes, and the former term is so used by most dipterists, while the designation frontal triangle is usually applied to the triangular median area anterior to the contiguous portions of the eyes (i. e., the area occupying the space between the eyes and the bases of the antennae). Some dipterists, however, do not restrict the designation frontal triangle to this area in holoptic forms alone, since Walton (1909) also includes in his definition of the frontal triangle, the "triangle indicated by color or depression in the dichoptic front." Bromley (1926) refers to the vertical triangle as the posterior vertex, and refers to the frontal triangle as the anterior vertex, in his description of the holoptic male of *Tabanus atratus*, although the areas which he calls the anterior and posterior vertex in the dichoptic female of this insect appear to be slightly different from the areas designated by these names in the male.

If the term vertex is used, in the broad sense, to indicate the general region at the top of the head (and always located above the antennae, instead of extending below the antennae as Peterson, 1916, considers to be the case), instead of restricting it to the region between the frons and the occiput, as is sometimes done, the designation vertex would then be restored to its original usefulness as a general term for the top of the head, for which no other designation is available, and it is strongly recommended that the term vertex be used in this sense alone.

In the Tipulidae shown in Fig. 1, F, Fig. 3, A, Fig. 4, H., etc., and other primitive Nematocera in which the eyes converge in both sexes, the converging eyes divide the vertex into an anterior vertex, *av*, and a posterior vertex, *pov*, and these terms are of considerable value for designating the areas of the head. Similarly, in the holoptic Diptera in which the contiguous eyes demark a vertical triangle and a frontal triangle, the designations posterior vertex and anterior vertex might readily be applied to these areas. In the dichoptic forms, however, in which the eyes do not tend to converge at a definite point to divide the vertex into an anterior and posterior region, these terms are not readily applicable, and are of little practical value in such cases.

The term parietalia, or parietal region, is applied by recent morphologists to the region *pa* (Fig. 1, A, F, etc.) between the frontal and occipital regions. The designations vertex and "epicranium" are sometimes also applied to this region, but it is preferable to use the term vertex as a general designation for the top of the head, as was mentioned above, while the term epicranium should be applied to the upper region of the head including the frons—as was done by Strauss-Duerckheim (1928), who introduced the term. In fact, Snodgrass includes the clypeus as well as the frons in the "epicranium", while Imms, who excludes the frons from the epicranial region, includes the occiput in it; and there is no uniformity in the application of this term to the areas of the head region, so that students of comparative morphology have discarded it in favor of the designation parietal region, for that portion of the head capsule between the frontal and occipital regions. The lateral areas of the parietal region, labelled *t* in Fig. 1, L, G, etc., which are located above the compound eyes, are called the temples or tempora.

An infolding of the head capsule contiguous to each of the compound eyes forms the so-called occular sclerite. This sclerite is best seen in an interior view of the head, and is scarcely visible from the exterior. The external areas surrounding the eyes are called the orbits; and these are sometimes referred to as the periorbital regions. Loew (1862, p. xiii) refers to the successive parts of the orbits as the anterior or facial orbits, the inferior or genal orbits, the posterior or occipital orbits, the superior or vertical orbits, and the frontal orbits. The frontal orbits correspond in a general way to the genovertical plates, and the facial orbits correspond to the parafacial plates previously described, etc.

In some Diptera, an antennal sclerite surrounds each of the antennal sockets, but it is not readily seen in most Diptera. Peterson

(1916) mistakes the reduced first antennal segment for this sclerite in the culicids, etc. An antennifer, or process upon which the antenna pivots, is found in the Diptera shown in Fig. 1, G, H, etc., in which it bears the label *af*. Peterson (1916) designates the sockets in which the antennae are attached as the "antennal fossae", but it is preferable to refer to them simply as the antennal sockets, since the designation antennal fossae is applied to the grooves in which the antennae lie, in the higher Diptera, and this usage of the designation antennal fossae is the one generally accepted by most dipterists.

The location of the points of attachment of the antennae varies greatly in different Diptera; and the extent of such areas as the face, or facies, etc., is largely determined by the position of the points of attachment of the antennae. Thus in the Phoridae, for example, the antennae are situated far down the head, on the "oral margin", and the face, or facial region, is thereby reduced to a negligible area, while in such forms as *Lonchoptera*, etc., the antennae are situated high in the dorsal region of the head, and the facial region is of correspondingly greater extent in this fly.

The points of attachment of the antennae may be far removed, dorsally, from the frontoclypeal suture (i. e., the suture *fcs* demarking the hinder region of the postclypeus *poc* of Fig. 1, B and L), or the points of attachment of the antennae may be located in the immediate neighborhood of the frontoclypeal suture (i. e., *fcs* of Fig. 1, H and J). The amount of variation in the location of the antennae with reference to the frontoclypeal suture is as great in the Orthorrhapha Brachycera shown in J and L of Fig. 1, as it is in the Nematocera shown in B and H of Fig. 1, so that this feature does not appear to be of great importance in distinguishing the Nematocera from the Orthorrhapha Brachycera (as Hendel considers to be the case). The occurrence of the ptilinal suture, *ptc* of Fig. 4, J (which, however, has nothing to do with the frontoclypeal suture), above the base of the antennae, on the other hand, is a feature of considerable importance in distinguishing the Cyclorrhapha from the Orthorrhapha Brachycera, and the relation of the antennae to this suture is more constant than is the case with the frontoclypeal suture.

In the tipulid shown in Fig. 1, F, the mouth parts are directed forward; and the long axis of the head lies more nearly in the same plane with the long axis of the body (as is also the case, to some extent, in the tanyderid shown in Fig. 2, H), and this arrangement naturally affects the position of the occipital foramen, *of*, (or foramen magnum, through which the alimentary tract, nervous system, etc., pass from the head into the thorax) situated at the hinder end of the narrow posterior region of the head in these insects. The occiput or occipital region, *oc*, of the tipulid shown in Fig. 1, F, is situated in the narrow posterior region of the head behind the parietal region, *pa*, which separates the occiput rather widely from the compound eyes; and in most tipulids the occiput is fairly well marked off from the parietal region in front of it.

In the anisopodid shown in Fig. 2, K, which approaches the Orthorrhapha Brachycera in many respects, the mouth parts are directed

more vertically downward and the long axis of the head makes an angle with the long axis of the body. The occipital foramen, *of*, consequently takes up a somewhat different position in the hinder region of the head, which becomes more flattened posteriorly as its surface (including that of the occiput, *oc*) assumes a position more nearly vertical to the long axis of the body. While the occipital foramen, *of*, is not so centrally located in the anisopodid shown in Fig. 2, K, as it is in the syrphid shown in Fig. 1, K, the condition exhibited by the anisopodid is somewhat intermediate between that exhibited by the tipulids, etc. (Fig. 1, F), and the higher Diptera (Fig. 1, K), and clearly indicates a modificational tendency in the direction of the higher Diptera.

The occipital region, *oc*, of *Anisopus* (Fig. 2, K) extends ventrad on each side of the occipital foramen to a point half-way down the sides of the foramen, *of*, where it merges with the postgenae, *pg*, or areas behind the compound eyes. The narrow marginal sclerites labelled *pag* in the anisopodid shown in Fig. 2, K, which are homologous with the paragular sclerites of lower insects, are called the parapostgenae by Peterson (1916).

In the higher Diptera, the hinder region of the head is usually rather sharply differentiated from the anterior region of the head, and its surface is frequently greatly flattened, or it may even become concave, as is the case in the syrphid shown in Fig. 1, K. The entire posterior region of the head is sometimes called the "occiput" in the higher Diptera, but the true occipital region includes only the upper region of the posterior portion of the head, and it is preferable to refer to the entire hinder region of the head as the postcranium (in contradistinction to the "precranium") in these insects. The posterior surface of the head usually lies at right angles to the long axis of the body, and the occipital foramen, *of*, occupies a central location in the postcranium of the higher Diptera (Fig. 1, K).

Superficial markings of the posterior surface of the head of the higher Diptera may divide it into areas to which various terms have been applied by different writers. Thus, the median sclerite, labelled *m* in Fig. 1, K (which may extend much further back toward the occipital foramen, *of*, in some Cyclorrhapha), is sometimes called the occiput by some dipterists, while those who follow Lowne call it the epicephalon, and those who follow Desvoidy call it the cerebrale. Hendel (1928) considers that the occurrence of the "cerebrale" is one of the chief distinguishing characters of the higher Diptera, as contrasted with the Nematocera.

The lateral occipital region, *loc* (Fig. 1, K), together with the postgenal region, *pg*, make up an area designated as the paracephalon or paracephalic plate by Walton (1909) who applies the designation metacephalon to the "gular" region, *gu*, having adopted most of these designations from Lowne's terminology.

The area *pao* (Fig. 1, K) surrounding the occipital foramen, *of*, is called the paroccipit by Peterson (1916). Snodgrass (1928, p. 39) designates this region as the postocciput in lower insects.

In the primitive blepharocerid *Edwardsina*, shown in Fig. 2, J, the so-called "gula" or throat region, *gu*, extends from the occipital foramen, *of*, to the gular or postentorial pits, *gp* (i. e., the external apertures of the invaginations forming the posterior arms of the tentorium); and in the syrphid shown in Fig. 1, K, secondarily formed sutures demark the so-called "gular" region, *gu*, from the postgenae, *pg*. It has been shown, however, that in the Diptera the so-called "gular" region is a "pseudogula" formed by the mesad approximation and union of the postgenae (or hypostomal areas), so that the so-called "gular" region of the Diptera is not strictly homologous with the gula of lower insects, and might be called a pseudogula to indicate this fact.

4. The compound eyes

The cornea of the compound eyes contains a number of facets (or lenses of the ommatidia or visual elements of the eye), which vary considerably in number and size. A common housefly, for example, may have about four thousand facets in each eye, while there is only one facet in the eyes of some streblids. Compound eyes with larger facets are better adapted for vision at night, or in dim light, while those in which the facets are smaller and more numerous are better adapted for vision by day—and the image produced by the latter type is probably much sharper.

The facets of one region of the eye may be larger than those of another region, and in such cases the larger facets are usually located in the dorsal portion of the eye, as in certain blepharocerids, etc. The larger facets may be in the middle of the eye, however, as in certain asilids, or they may be in the ventral region of the eye, as in certain empids, etc. In some blepharocerids, in which the facets of the upper half of the eye are larger than those of the lower half, the two regions of the eye are divided by a constriction, or narrow band in which there are no facets, and a somewhat similar constriction occurs in the postero-ventral region of the compound eyes of certain bibionids.

When the eyes are dichoptic (separated) in one sex, and holoptic (contiguous) in the other, they are typically holoptic in the males alone, as is true of the Leptidae, Stratiomyidae, Tabanidae, Pantophthalmidae, Therevidae, Scenopinidae, Nemestrinidae, Bombyliidae, Syrphidae, Pipunculidae, Platypezidae and other higher Diptera in which the eyes are contiguous, but in such empids as *Hybos*, or in the bombyliid *Systropus*, and in certain Cyrtidae, the eyes are contiguous in the females also. In some Nematocera, such as the Anisopodidae (excepting *Mesochria*), Bibionidae, Simuliidae, etc., holoptic eyes may occur in the males alone, while in certain Blepharoceridae, and in the Orphnephilidae, the eyes may be holoptic in both sexes.

In some scatopsids, cecidomyids and sciarids, the narrow upper portions of the compound eyes become approximated to form a narrow bridge extending from one eye to the other across the area between the ocelli and the bases of the antennae. This condition is called "zygophthalmie" by Enderlein, who considers that its occurrence indicates such a close relationship in the few Nematocera in which it occurs, that

the sciarids should be separated from the mycetophilids, and should be grouped with the cecidomyids and scatopsids instead, although numerous fundamental resemblances between the sciarids and mycetophilids clearly indicate that they should be grouped together, as is done by most dipterists.

The compound eyes are contiguous above in many cecidomyids, but in the genera *Triommata* (Barnes) and *Trisopsis* (Kieffer) the lower portions of each eye become separated from the contiguous upper portions, with the result that there appear to be three compound eyes in these insects, two eyes being lateral and the composite third being dorsal in position. In *Triommata*, the median dorsal composite eye is connected with the lateral eyes by a narrow strand on each side, but in *Trisopsis* the connecting strip on each side is lost, and the three distinct parts of the eyes have the appearance of three compound eyes as is shown in Fig. 1, I.

When the eyes are contiguous, they are usually approximated above the bases of the antennae, although they may become approximated below the antennae in some empids, dolichopodids and cyrtids. In *Oncodes gibbosus* (Fig. 1, D) the eyes are contiguous for a considerable distance between the ocelli, *o*, and the antennae, *ant*, and widely separate the antennae from the ocelli, while in *Acrocera globulus* (Fig. 1, E) the eyes are contiguous below the antennae, which remain near the ocelli in the latter case. The eyes rarely extend onto the ventral surface of the head, as they do in the mosquito *Psorophora*, but in some tipulids, such as the males of *Erioptera megophthalmia*, they are contiguous on the ventral surface of the head behind the rostrum.

The compound eyes are hugely developed and occupy most of the surface of the head region in certain cyrtids, pipunculids, etc., while in some of the wingless myrmecophilous and termitophilous phorids, and in the parasitic braulids, streblids and nycteribiids, they are greatly reduced. According to de Meijere (1916, p. 51), the compound eyes appear to be completely lost in some of the wingless phorids, streblids and nycteribiids, although minute vestiges of the eyes might escape detection in such small insects, unless they were examined under the higher power of the microscope.

In the Diptera which live as ectoparasites on various hosts, the eyes and antennae alike are reduced, but in other Diptera there is frequently a correlation between the development of the eyes and that of the antennae. Thus, in the Nematocera, in which the antennae are longer and are better developed, the eyes are usually smaller with larger facets, while the Orthorrhapha Brachycera and Cyclorrhapha, in which the antennae are shorter and more reduced, usually have somewhat larger eyes with smaller facets, which are more densely crowded together.

The eyes are usually bare in the Nematocera; and in the tipulids, for example, only the Pediciini have short erect setae between the facets. In the Tanyderidae, on the other hand, all of the species have hairs between the facets of the eyes, and in the males of certain bibionids, the hairs on the eyes are long and numerous. Pilose eyes occur more frequently in the higher Diptera and are found in some of the stratiomyids, tabanids, empids, cyrtids, ephydrids, tachinids, etc.

5. Ocelli

There are typically three ocelli in the Diptera, although some of them, such as the anisopodid *Mycetobia* and the cyrtid *Oncodes*, lose the median ocellus, and in other Diptera all of the ocelli may be wanting. The presence or absence of the ocelli is a feature of considerable phylogenetic importance in the Nematocera, but it is of less significance in the other Diptera.

The ocelli are wanting in the Tipulidae, and in the psychodoid families Psychodidae, Tanyderidae and Ptychopteridae, and are typically absent in the Orphnephilidae, Simuliidae, Chironomidae, Dixidae and Culicidae, which are apparently descended from psychodoid ancestors. They are present, on the other hand, in the Trichoceridae, and in the Anisopodidae, which lead up to the bibionoid forms; and the ocelli are also present in the Bibionidae, Mycetophilidae, etc., which were descended from ancestors related to the Anisopodidae. Ocelli are likewise present in the rather isolated family Blepharoceridae, whose closest affinities have not as yet been determined.

The ocelli are preserved in many of the Orthorrhapha Brachycera and Cyclorrhapha, and their presence in these forms is one of the many features which indicate that they were descended from ancestors resembling the Anisopodidae. The ocelli become atrophied in some of the Tabanidae, and are vestigial or absent in the Mydaidae. They are also wanting in certain aberrant Phoridae, in some Conopidae, and in certain Hippoboscidae; and they are also said to be absent in the Braulidae, Streblidae and Nycteribiidae, but the absence of the ocelli in these forms is a later specialization, and has no connection with the loss of the ocelli in any of the Nematocera.

6. Antennae

Although the function of the antennae is primarily tactile, they also contain well-developed olfactory organs, and may likewise be modified for receiving auditory stimuli, etc. The so-called Johnston's organ* is found in the second antennal segment of such diverse Diptera as *Chaoborus* and *Calliphora*, and is greatly developed in the male mosquito, whose long antennal hairs are thrown into sympathetic vibration by the humming note of the female. The occurrence of this organ in the enlarged second segment labelled *p* in Fig. 5, V, proves that this segment of the antenna of a mosquito is the true second segment, or pedicel, (and not the first segment or scape as Peterson (1916) maintains), as is also shown by comparing the parts in a series of Diptera leading back through the chironomids to the dixids and tanyderids, etc.

The antennae are usually situated rather close together, and they may even be connected basally, as in the cyrtid *Pialea*. In the diopsid series represented by the genera *Sphyrocephala*, *Diopsina* and *Diopsis* (Curran (1934), p. 358), they become increasingly more widely sepa-

*According to Eggers these structures may serve as "tension receptors" or chordotonal organs, or being stimulated by displacement of the antenna, may serve to detect air currents, etc.

rated, as the eye-stalks on which they are borne become more and more lengthened. In the male of *Richardia telescopica*, however, the antennae remain close together, while the eye-stalks become greatly prolonged (as a sexual character exhibited by the male alone).

The antennae may exhibit some very striking sexual differences in the Diptera. Thus the segments of the antennae of the male of the tipulid *Cerozodia plumosa* bear long processes which give a feathery appearance to the antennae (compare Fig. 5, U) in this sex, although the antennae of the sub-apterous female of this species are of the normal type. A more familiar type of sexual dimorphism in the antennae is illustrated by the densely verticillate "feathery" antenna of a male mosquito, such as the one shown in Fig. 5, V, which presents a marked contrast to the sparcely verticillate type of antenna occurring in the female (Fig. 3, E). Among the higher Diptera, the tachinid fly *Talarocera nigripennis*, figured by Williston (1908, p. 31), has the third segment of the antenna of the male modified in the peculiar fashion shown in Fig. 5, R, while the third segment of the antenna of the female is rather deeply cleft, giving it a somewhat furcate appearance.

The antennae of the males of such tipulids as *Megistocera filipes*, *Macromastix costalis*, etc., are extremely elongated, although the number of antennal segments is reduced to about eight, and the lengthening of the antenna (which may be one or more times the length of the body) takes place through the lengthening of the individual segments, rather than by an increase in the number of the segments. In the mycetophilid genus *Macrocera*, the antennae are extremely elongated in both sexes.

The antennae are extremely reduced in the Hippoboscidae; and the segments are so greatly modified that Dufour (1845) thought they consist of but a single immobile segment in these flies. Traces of three segments may be found in the antennae of the hippoboscids, however, although the first segment is so reduced and so highly modified that it is difficult to recognize it. The second segment, labelled *p* in Fig. 5, O, is the largest, and conceals the third segment, which is withdrawn into the sacciform second segment (from which the arista, *ar*, borne by the third segment, may be protruded).

According to Felt (1921), "The normal number of antennal segments among generalized Nematocera is probably 16—that is, a greater or smaller number means specialization by addition or reduction." Felt (1925) likewise records the remarkably great number of 41 segments* for the antenna of the cecidomyid *Lasioptera perarticulata*, while the Mexican cecidomyid *Ceratomyia*, described by him, has the antennae reduced to "comparatively insignificant and presumably functionless organs with but six segments" (which is the minimum for the Nematocera in general), so that the cecidomyids present as great a variation in the number of antennal segments as is to be

*Alexander (1936) has described a cecidomyid from Panama, *Feltomyia polymera* (changed to *Feltomyina polymera* by Alexander, 1937), having 65 antennal segments; and Tonnoir (1939) has described an African bruchomyine psychodid, *Bruchomyia edwardsi* (changed to *Eutonnoiria edwardsi* by Alexander, 1940), having the remarkably large number of 113 antennal segments—the greatest number of antennal segments thus far recorded for the Diptera.

found in any family of Diptera. The binodose condition occurring in the individual antennal segments of certain cecidomyids makes it very difficult to determine the exact number of segments in the extremely delicate antennae of these insects, but in the tipulids it is quite easy to distinguish the segmentation of the antennae, and the amount of variation found in the tipulids, ranging from the maximum of 39 segments found in *Cerozodia* to a minimum of 6 segments found in *Hexatoma*, compares rather closely with that recorded for the cecidomyids by Felt.

The antennae furnish excellent taxonomic characters which are much used in the classification of the Diptera, but there is no general agreement concerning the proper application of some of the terms employed in referring to the parts of the antennae. Thus, the word "joint", in the strict sense of the term, should indicate the membranous articulatory region which is usually devoid of bristles or setae, so that it is quite inaccurate to speak of the bristles, etc., borne on the "joints" of the antennae, and it is preferable to refer to the region between the joints as a segment.

In all other groups of insects, the first, or basal, segment of the antenna is called the scape, and the second segment is called the pedicel, but dipterists frequently misapply the term "scape" to the two basal segments of the antennae, although there is no reason why they should not be as accurate as other taxonomists in this respect. The third segment of the antenna is called the postpedicel in lower insects, and it constitutes the first segment of the flagellum, or portion of the antennae distal to the second segment (pedicel) in these forms. Hendel (1928), however, would make the three terms postpedicel, funiculus and flagellum, synonymous with designations applied to the entire antenna distal to the pedicel, leaving no term available for the true postpedicel, or third segment, although such a designation should be very useful in such Diptera as the Cyclorrhapha, etc., in which the three basal segments form most of the antennae, and the latter usage has been adopted here.

In the higher Diptera, the segments distal to the third segment, or postpedicel, are so greatly reduced that the portion of the antenna which they form appears to be merely a slender appendage of the trimerous antenna. When this appendage is slender and flexible, or bristle-like, it is called an arista. The arista may be dorsal, if it is borne on top of the third segment, or it may be sub-basal, if it is borne near the base of the third segment, or it may be terminal or apical, if it is borne at the tip of the third segment. The arista may be bare, plumose, pectinate, etc., according to the occurrence and arrangement of the hairs, etc., it bears; and the character of the arista has considerable classificatory value in some groups of higher Diptera.

When the reduced segments distal to the third segment form a stouter and more rigid appendage, it is called a style; and the style is always terminal. Unfortunately, the term, styli, is applied to the styliform abdominal appendages of lower insects, and according to some investigators certain of these styli are supposed to form the distal portion of the forceps, or claspers, of male insects; and in the

females of higher Diptera the piercing tip of the "ovipositor" is also called a style. If the Latin form "stylus" is used for the abdominal styli, it is possible to use the English form of the word for the antennal "style" without creating undue confusion, but the designation "ceratostyle" is more specific for the antennal structure, and should be used where there is any chance of confusing the terms. The distinction between a style and an arista is not always very clear, since the two types of structures intergrade, but in such cases it is unimportant which term is applied to the structure—except that a style is always terminal, while an arista may be either terminal or dorsal.

The arista-bearing type of antenna mentioned above is called aristate (Fig. 5, W), while the stylus-bearing type is called stylate (Fig. 5, G). When the segments of the antenna bear processes giving it a comb-like appearance, it is called pectinate; and if the processes are double, it is called bipectinate (Fig. 5, H). If the processes are very long, as in Fig. 5, U, the antenna is called flabellate, although this type of antenna is not quite the same as the flabellate type in the Coleoptera. When the segments of the antenna bear whorls of hairs, as in Fig. 3, E, the antenna is called verticillate, and when the whorls of hairs are very dense, giving the antenna a feathery appearance, as in Fig. 5, V, it is called plumose, although this type of antenna is not the same as the plumose antenna of a male moth, for example, and it would be more accurate to refer to it as densely verticillate. The verticillate antenna of the psychodid shown in Fig. 5, C, approaches the nodose type occurring in many cecidomyids, in which the central portion of the segments is swollen to form a knot. If the knots are not widely separated, and give a beaded appearance to the antenna, it is called moniliform. The club-shaped antennae of certain asilids, mydaids, etc., are called clavate; and the slender thread-like antenna of the trichocerid shown in Fig. 5, A, is called filiform.*

It has been suggested that a 16-segmented, filiform type of antenna, like that of *Trichocera* (Fig. 5, A), in which the scape, *s*, and pedicel, *p*, are rather short, and the postpedicel, *pp*, is fairly long, represents the basic type for the Diptera in general,** and this type is very like the antenna of the mecopteron *Bittacus*, which has retained many of the features of the ancestors of the Diptera. A slight advance is illustrated by the *Anisopus* type shown in Fig. 5, E, in which the segments become somewhat broader; and in some of the higher Nematocera, such as the simuliid shown in Fig. 5, D, the antenna becomes greatly shortened, and the number of segments is reduced. In the tabanids (Fig. 5, I), the four distal segments become much smaller than the three basal ones, while in the asilids (Fig. 5, G), the distal segments become still more reduced, although the three basal segments are well developed. In the oscinid fly shown in Fig. 5, Q, the postpedicel, *pp*, still bears the smaller segments at its tip, but its ventral region becomes prolonged downward to some extent, and this tendency

*Many more types of antennae occur in the Diptera, and some of these are of considerable interest—e. g., the broad compressed antennae of the mycetophilid *Ceroplatus* (Fig. 5, F) which have "foliaceous", flattened, leaf-like segments, etc.

**It is probable, however, that the ancestors of the Diptera had antennae composed of more numerous segments.

becomes increasingly more pronounced, until in such a fly as the psilid shown in Fig. 5, T, the ventral prolongation of the postpedicel results in the formation of an extremely elongated segment bearing the arista in the region which was originally terminal, but now has the appearance of being dorsal or subbasal in position.

Some of the segments which normally enter into the composition of the arista apparently unite with the third antennal segment, instead, in some forms, as is the case in the stratiomyid shown in Fig. 5, K, in which the apparent third segment is divided into four "annulations", which probably represent four uniting segments. The arista of the South American tachinid shown in Fig. 5, S, is rather interesting from the fact that its terminal segment is greatly enlarged. The row of long branched hairs borne on the arista of the tsetse fly shown in Fig. 5, W, gives it a very peculiar appearance in the antenna of this fly.

From the morphological standpoint, it is very unfortunate that the former incorrect method of referring to the number of antennal segments is still retained by many modern dipterists, despite the fact that many of them have abandoned the old division of the Diptera into the suborders Nematocera and "Brachycera" (*sensu lato*), which was based upon a misconception of the number of segments composing the antennae. When any of the "Brachycera" were found to have more than three antennal segments, those segments distal to the third were formerly interpreted as secondary "annulations" of the third segment, and the small segments visible in the arista, etc., of some Diptera were regarded as subdivisions of an appendage of the supposedly three-segmented antenna. The number of antennal segments in the brachycerous leptid (or rachicerid) fly, *Rachicerus* (Fig. 5, M), however, may be as high as 28, while in the great majority of the Nematocera the number of antennal segments is much less, and only a very few Nematocera equal or surpass *Rachicerus* in the number of segments found in the antennae. There are ten very distinct and well developed segments in the antenna of such a stratiomyid as the one shown in Fig. 5, P, and no amount of arguing could convince an unbiased morphologist that the well developed, separate segments beyond the third are merely "annulations" of the third segment. Even when the terminal segments of the antenna are reduced to form a style, as in the asilid shown in Fig. 5, G, or an arista, as in the oscinid shown in Fig. 5, Q, the segments can frequently be clearly seen, and it is morphologically incorrect to speak of such an antenna as three-segmented, although it may be convenient to do so in taxonomic descriptions.

7. Mouth parts

The labrum, *lr*, or upper lip, is morphologically a portion of the head capsule, while the true mouth parts (i. e., the mandibles, maxillae, and labium or united second maxillae) are highly modified limbs of the gnathal segments entering into the composition of the head region, but since the labrum is functionally one of the mouth parts, it may be considered under this heading.

The labrum is small in some Nematocera such as *Trichocera* (Fig. 1, G) and most mycetophilids (Fig. 1, H), and is membranous in *Rhabdophagus* and *Chironomus*; but in certain other Nematocera, such as the blepharocerid shown in Fig. 1, B, it is well developed and is strongly sclerotized. The labrum is greatly elongated in the tipulid *Geranomyia* (Fig. 4, H) and in the female culicid shown in Fig. 3, E. It is well developed in the piercing mouth parts of the tabanids (Fig. 1, J), and is much elongated in the tabanid *Pangonia longirostris*. It is also considerably elongated in the cyrtid shown in Fig. 3, C. As a rule, the labrum is only moderately developed in the Cyclorrhapha, but it may become rather long in some of these also, as is the case in the syrphid shown in Fig. 4, B.

The labrum usually forms the roof of the food canal (or food channel), and the hypopharynx usually forms its floor in the higher Diptera. Radial muscles, extending between the outer (anterior) walls of the labrum and the walls of the epipharynx, serve to dilate the lumen of the food channel extending between the labrum and the hypopharynx, and aid in sucking up liquid food.

The epipharynx is formed by a sclerotization of the hinder or "inner" surface of the labrum (i. e., the surface which would be ventral in the prognathous position); and the epipharynx is therefore not a distinct and separate structure which has united with the labrum to form the so-called "labrum-epipharynx", as is claimed by some dipterists. The epipharyngeal region of the labrum is not greatly modified as a rule, but in some of the Dolichopodidae chitinized prongs project from the epipharyngeal region, and were mistaken for mandibles by Langhoffer (1888).

The hypopharynx, *hp*, is an unpaired, median, stylet-shaped structure immediately behind the labrum, *lr* (Fig. 4, B), with which it is frequently associated to form the floor of the food-channel, whose roof, and sides, are formed by the labrum, *lr* (Fig. 4, F). The salivary duct, *sd*, of Fig. 4, E, enters the basal portion of the hypopharynx, and is continued as a channel extending to its tip, in many Diptera. A dilation of the salivary duct in this region forms the salivary bulb, or syringe, occurring in many Diptera. The development of the hypopharynx frequently parallels that of the labrum, and in such a tipulid as *Geranomyia* (Fig. 4, H), the hypopharynx, *hp*, becomes extremely elongated when the labrum, *lr*, becomes elongated, while it is greatly reduced in the tipulids which have a short labrum. In the nycteribiids the hypopharynx may be much longer than the labrum, but in the cyrtid *Lasia* shown in Fig. 3, C, it is much shorter than the elongated labrum, *lr*.

The hyoid sclerite, *ho*, of Fig. 4, E, is a sclerotized area situated in the basal region of the labrum and hypopharynx, and forms a connecting capsule between the food channel (extending between the labrum and hypopharynx) and the food pump in the floor of the fulcrum. Hendel (1928) calls the hyoid sclerite the "theca", although other dipterists apply the designation "theca" to the prementum, etc.

The fulcrum, *fu*, of Fig. 4, B and E, is a stirrup-shaped, internal structure, sometimes referred to as the "pharyngeal skeleton", al-

though it is not regarded as a part of the pharyngeal region by most recent investigators. Peterson (1916) considers that the posterior region of the fulcrum is formed by the basal portions of the epipharynx and hypopharynx, while its anterior portion is formed by the "tormae", although the external sclerite, *ac*, of Fig. 4, B, E and J, which Peterson designates as the "tormae" in higher Diptera apparently represents the anteclypeus, or the united anteclypeal sclerites (clypeites), of the orthopteroid insects. The fulcrum is borne at the basal, or dorsal, end of the labrum in many Orthorrhapha Brachycera; but in the Cyclorrhapha it becomes intimately associated (anteriorly) with the external anteclypeus, *ac*, which acts as a supporting plate for the fulcrum, while permitting the folding movements of the basal portion of the proboscis, or oral cone, within which the fulcrum is situated. The food pump and other structures connected with the fulcrum will be described under the discussion of the feeding mechanism of the higher Diptera.

The mandibles of the Diptera are slender, elongated structures, resembling the mandibles of the Mecoptera very closely. They are present in the females of some Psychodidae (such as Phlebotomus), Dixidae, Culicidae, Ceratopogonidae, Simuliidae (present in both sexes), Blepharoceridae and Tabanidae, etc., but have been recorded as occurring in the males of only three families. Peterson has found them in the males of two species of *Simulium*; Wesché has recorded their occurrence (as abnormalities) in a few male mosquitoes; and Jobling describes them in males of *Culicoides pulicaris*. The mandibles are usually slender, stylet-like structures, but in certain blepharocerids they are blunt at the tip, and are serrate along the mesal margins, which fit against the lateral margins of the hypopharynx. They are much elongated in the culicids (Fig. 3, E), and are quite long in the tabanid *Pangonia longirostris*. In *Culicoides* and *Tabanus* (Fig. 4, G), the mandibles, *md*, intervene between the hypopharynx, *hp*, and the labrum, *lr*, and ventrally close the food channel, whose dorsal and lateral walls are formed by the labrum, *lr*, although the hypopharynx usually forms the floor of the food channel in the higher Diptera. The mandibles likewise intervene between the labrum and the hypopharynx in such simuliids as *Simulium hirtipes*.

The mandibles are attached to the head capsule between the base of the labrum and the base of the maxillae, and are usually associated with the anterior arms of the tentorium. Unless the mandibles are identified by the location of their points of attachment to the head (in front of the base of the maxilla, and behind the base of the labrum), all sorts of structures may be mistaken for the mandibles, such as the epipharyngeal prongs of the Dolichopodidae (Langhoffer, 1888), the labral hooks of the Simuliidae (Smith, 1890), the maxillary stipes of *Musca* (MacCloskie, 1880), and the sclerotized bands of the labium in various Diptera (Wesché, 1909), etc., so that the importance of this feature should be emphasized very strongly.

The maxillae of the primitive Diptera (Fig. 2, K) are extremely like those of the mecopteron *Nannochorista* (Fig. 2, I), and are made up of a laterally directed basal segment, or cardo, *ca* (Fig. 2, K), an

elongated stipes, *sti*, a slender galea,* *g*, and a maxillary palpus, *mp*, which may be composed of five segments in some primitive Diptera, and is borne on a palpifer in such primitive forms as *Tanyderus* (*pfr* of Fig. 2, H) and some female mosquitoes (Fig. 3, E), in which the palpifer, *pfr*, has the appearance of a small vestigial segment of the maxillary palpus. The so-called "lacinia" of certain Diptera, such as *Tabanus* and *Simulium*, is apparently homologous with the sclerite labelled *il* (the interlorum) in the maxilla of the hymenopteron *Bracon liberator* shown in Fig. 69, Plate 16, Vol. 31 of the Journal N. Y. Ent. Society for 1923, and is connected with the hypopharynx in all of these insects.

The cardines, *ca*, are rather typically developed in many Anisopodiae (Fig. 2, K), Trichoceridae** and Dixidae, and also in the females of the Tabanidae. They are greatly developed in the Simuliidae, but are not clearly distinguishable in most Diptera other than these forms. The cardines are usually associated with the invaginations of the posterior arms of the tentorium; but in the higher Diptera the maxillae are no longer associated with the tentorial structures.

The stipites, *sti*, are slender in such primitive Diptera as *Anisopus* (Fig. 2, K); but in such forms as *Bittacomorpha* (Fig. 2, A), they are broader, and become approximated mesally in the anterior region. In many asilids (Fig. 2, F) the stipites, *sti*, merge mesally to form a "zygostipes", *zs*, or composite plate, formed largely by the connected stipites. In the mycetophilid *Asyndulum* (Fig. 2, C), the stipital plate is demarked into a median region, *mn*, (which occupies the same position as the mentum of certain other forms—*mn* of Fig. 2, E) and two lateral regions, *sti*, which represent the stipites, so that the stipital plate in such cases is probably formed by a combination of the stipites with the mentum. In the higher Diptera, according to Peterson (1916), the stipites gradually project more and more beneath the surface of the proboscis, and finally become internal, apodeme-like*** structures (cryptostipes), such as that labelled *cr* in Fig. 4, E and B (here referred to as the maxillary apodeme or tendon).

The galeae, *g*, are usually short in the primitive Diptera (Fig. 2, K), and, according to Hendel (1928), they close the sides of the food channel formed by the labrum and hypopharynx in such lower Diptera as *Bolitophila* and *Diadocia*, etc. In some Nematocera, such as the culicids (Fig. 3, E), they are quite long. In the tabanid *Pangonia longirostris* they are extremely long, and are also quite long in such cyrtids as the one shown in Fig. 3, C. They are also well developed in such syrphids as the one shown in Fig. 4, B. The galeae become rather short in most of the Cyclorrhapha, and are atrophied in some of the higher forms (and in some of the Nematocera as well).

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*Rees and Ferris (1939) interpret the galea as a lacinia in *Tipula*, although the comparative studies of the maxillae by Crampton (1923, Journal New York Ent. Society, 31, p. 77) indicate that the galea of the Diptera is homologous with the galea of other insects.

**The character of the cardines and stipites of the Trichoceridae is essentially like that of the Anisopodidae and differs from that of the typical Tipulidae.

***Snodgrass (1935) calls these structures the rostral apodemes, and considers that they are parts of the labrum, although Peterson (1916) regards them as parts of the maxillary stipites. They are here designated as the maxillary apodemes since they appear to be internal structures of the maxillae developed for muscle attachment.

The maxillary palpi, *mp*, are best developed in the Nematocera, and the third segment of the palpus bears a peculiar sense organ, *so*, in such Nematocera as *Edwardsina* (Fig. 2, J), *Anisopus* (Fig. 2, K), etc., like that of the mecopteron *Nannochorista* (Fig. 2, I). In the Nematocera, the palpal segments may vary from one, in such tipulids as *Conosia* and *Hexatoma*, to five in the tanyderids (Fig. 2, H) and the culicids (Fig. 3, E). According to Williston (1909, p. 26), "Theobold says that some Culicidae have six (palpal) joints, but his statement needs confirmation." The supposed sixth palpal segment described by Theobold may possibly be the palpifer, *pfr*, of the culicid *Anopheles* shown in Fig. 3, E. This culicid, and the tanyderid shown in Fig. 2, H, are the only Diptera in which a true palpifer has been observed, and it is very probable that the so-called palpifer of female tabanids is merely a prolongation of the stipital region of the maxilla. There is usually only one segment in the palpi of the brachycerous Orthorrhapha and the Cyclorrhapha, and this becomes reduced to a small vestige in *Mydas* (which preserves the maxillary galea), and is completely lost in *Conops*, although a vestige of the galea is preserved in the latter insect. The maxillae are so greatly reduced in the higher Diptera, and their parts are so highly modified, that many of the earlier observers were unable to interpret these structures correctly; and investigators, such as Wesché (1909), have interpreted the maxillary galeae as the "palpi" of the maxillae, and have consequently interpreted the true maxillary palpi as "labial" palpi, etc.

The labium, *li*, is usually the largest of the mouth parts, and frequently forms a trough or "gutter" in which the other mouth parts lie. The labium of the lower Diptera is strikingly similar to that of the mecopteron *Nannochorista* (Fig. 2, I), and a comparison between the two types of insects is very instructive for interpreting the parts in the Diptera.

The mentum, *mn*, is developed as a distinct plate in some species of *Anisopus* (Fig. 2, K). The mentum, *mn*, is extremely elongated in *Tanyderus* (Fig. 2, H), and resembles that of the mecopteron *Harpobittacus* (Fig. 2, E) in this respect. In *Asyndulum* (Fig. 2, C) the mentum, *mn*, forms the median region of the stipital plate, whose lateral portions are formed by the stipites, *sti*; and in *Tanyderus* (Fig. 2, H) the stipites, *sti*, likewise tend to unite with the elongated mentum.

The prementum, *pm*, which is one of the most important of the labial sclerites, is formed by the union of the columnar sclerites called the "palpigers" in the labium of the Coleoptera, but these sclerites include a large portion of the labial stipites as well,—and in fact are largely composed of the labial stipites. A suture, or a deep groove, which marks the line of union of the two parts of the prementum, *pm*, is preserved in the labium of many primitive Diptera (Fig. 2, C), but nothing like this occurs in a typical mentum, *mn* (Fig. 2, K), which is typically a single undivided plate, so that it is difficult to understand why many investigators misinterpret the prementum as the "mentum" in the Diptera. Furthermore, the prementum of the Diptera bears

the labial palpi, *la* of Fig. 2, J, as it does in the more primitive forms (Fig. 2, E), while the true mentum never bears the palpi in this fashion, and there can be little doubt that the sclerite here designated as the prementum in the Diptera is homologous with the prementum of the lower forms.

The prementum, *pm*, is a well developed plate in *Bittacomorpha* (Fig. 2, A), and forms the principal sclerite of the proboscis of the higher Diptera (Fig. 2, G; Fig. 4, A, E and B). It is the portion of the labium which becomes elongated in the mosquito (Fig. 3, E), and the prementum is also greatly elongated in the cyrtid shown in Fig. 3, C, as well as in such tabanids as *Pangonia longirostris*, etc. The prementum is usually called the theca by dipterists, although Hendel (1928) also applies the term theca to the hyoid sclerite. The crumena of scale insects is also called the theca, and the basal region of the aedeagus of the male, in the higher Diptera, is likewise called the theca, while in the caddice worms this term is applied to the case carried by the larva, and the term theca is also applied to the outer covering of pupal insects and various other structures, so that it is preferable to apply the designation prementum (instead of "theca") to the sclerite in the Diptera which is homologous with the prementum of other insects in general.

The labella, *la*, of the lower Diptera are the slender, two-segmented structures borne on the distal ends of the halves of the prementum, *pm*, (Fig. 2, J), exactly as is the case with the slender, two-segmented labial palpi of the Mecoptera shown in Fig. 2, E and I. In the pupa of the primitive tanyderid *Protoplasa*, the labella arise exactly as the labial palpi do in the pupae of the Lepidoptera (compare Fig. 3 with Fig. 4 of Plate 3 of paper by Crampton, 1930), in which no one disputes that the structures in question are the labial palpi, so that it is difficult to understand how anyone could mistake the labial palpi of the Diptera for paraglossae, and other structures with which they have been homologized by different investigators. The labella frequently bear labellar processes, or labellar lobes, *lp*, in the lower Diptera (Fig. 2, C, D and J), and these lobes are interpreted as the "glossae" by Peterson (1916), MacGillivray (1923), and others who consider that the labella represent the paraglossae of the labium.

The basal segment (basilabellum) of the labella, *bl*, may be longer than the distal segment, *dl*, (distilabellum) in such primitive blepharocerids as *Edwardsina* (Fig. 2, J—compare also Fig. 2, I), in which the slender, two-segmented labial palpi are distinctly separated; but the distal segments usually develop at the expense of the basal ones, and become lobe-like structures, which are connected basally, and are known as the oral lobes in the higher Diptera. The labella are long and slender in such Nematocera as the tipulid *Geranomyia* (Fig. 4, H) and in the blepharocerid shown in Fig. 3, D; and Edwards (1931) has described a chironomid, *Rhinocladius longirostris*, in which the labella are as long as the entire body—which is probably a record for the Diptera. In the empid *Empis clausa*, the labella are slender and elongated, but in the higher Diptera they are usually broad lobes. In the stable fly *Stomoxys*, and in *Glossina*, and also in the hippoboscids, the

labella are greatly reduced so that they will not impede the piercing operations of the proboscis, while in certain mycetophilids, on the other hand, they are extremely broad, membranous lobes, which may become united to form a single broad lobe as in *Mycetophila*.

In the higher Diptera, the membranous, lobe-like labella can be dilated by blood pressure, and they are also operated by muscles attached to the anterior labellar sclerite, *als*, (also called the discal sclerite), and to the posterior labellar sclerite, *pls*, (also called the furca, although this term has been applied to the endosternal apophyses of the thorax, to the spring of certain Apterygota, etc.) shown in Fig. 4, E. The small basal sclerites labelled *b* in Fig. 2, A of the labium of *Bittacomorpha*, etc., are sometimes interpreted as the vestigial labial palpi in these forms, but they belong in the same category with the numerous secondary plates developed in the basal region of the labella.

Pseudotracheae, *pt*, or small sclerotized grooves, resembling tracheae in appearance, are developed on the "oral," mesal, or pseudotracheal surface of the labella; and in association with these, small prestomal teeth are formed in many muscoid flies, in which these accessory "teeth" are used as rasping structures which are exposed and brought into play when the labella are everted or folded back. These "teeth" become increasingly larger and more important in the muscoids leading to the blood sucking forms,* such as *Stomoxys* and *Glossina*, in which the labella are reduced and the "teeth" are used in the piercing operations of these flies.

The pseudotracheae, *pt*, are represented by two simple, unbranched channels on each labellum in a primitive dipteran of the *Tipula* type, while in such a higher type as *Tabanus*, each of the labella bears two main pseudotracheal trunks, one anterior and one posterior, which give off more or less parallel branches extending over the pseudotracheal, or "oral", surface of each labellum; and from such a type, the pseudotracheae of the Cyclorrhapha could be derived. In the housefly, according to Hewitt (1914, p. 16), twelve pseudotracheal branches extend over the oral, or pseudotracheal, surface of the labellum from the anterior trunk, and about twenty branches are given off by the posterior trunk, while a "median set of three or four pseudotracheae run direct into the oral aperture . . . . . . (which) lies at the base of the small oral pit, which is a space kept open between the oral lobes by means of the discal sclerites."

The channels of the pseudotracheae are not complete tubes, since a zigzag, longitudinal cleft or fissure (*f* of Fig. 4, K) extends down each of them, and interrupts the taenidia-like, incomplete hoops, or loops, which prevent the channels from collapsing. The loops are bifid, or forked, at one end (*i* of Fig. 4, I and K) and are broadened at the other end, which is not bifid; and the loops are so arranged that the bifid end of one loop alternates with the broadened end (or base) of the next loop, in the series extending along the sides of the cleft

*The prestomal teeth are so large and powerful in the fly *Musca crassirostris*, that this fly can use them to scrape down to the blood-containing tissues of cattle to obtain blood to feed upon despite the fact that the labella are not otherwise modified for piercing.

(Fig. 4, K and I). The openings between the arms of the forks of the bifid ends of the loops are called the interbifid spaces (*i* of Fig. 4, K and I); and small grooves on the surface of the labellum open through these interbifid spaces, into the lumen of the pseudotracheae. These interbifid spaces form a filtering apparatus for straining out the larger particles of food when the dissolved food is taken into the pseudotracheae (probably through capillary attraction), and passes from them into the collecting channels and "oral aperture", to be taken up into the food channel between the labrum and hypopharynx, etc.

The proboscis is made up of the mouth parts (exclusive of the maxillary palpi), but the labium is by far the most prominent feature in its composition. The proboscis is greatly reduced in *Oncodes* and *Gastrophilus;* and in *Oncodes* there is no opening of the alimentary tract through it to the exterior, according to Peterson (1916). In most of the higher Diptera the proboscis is readily protruded and retracted: and the hinged regions, where the foldings take place, divide the proboscis into characteristic parts, or regions, to which various names have been applied.

The proximal region of the proboscis, *bpr* of Fig. 4, B, E and J, is called the oral cone, rostrum, or basiproboscis, and extends from the subcranial or "oral" margin, *om* of Fig. 4, B, to the hinge at the proximal end of the prementum, *pm* of Fig. 4, E. It bears the labrum, hypopharynx, maxillary palpi and galeae (Fig. 4, A), and contains the internal fulcrum and the apodeme-like cryptostipes, or rostral apodemes (*fu* and *cr* of Fig. 4, E), and is largely made up of the membranous region around the anteclypeus, and that around the mentum, together with the areas about the maxillae, etc. This portion of the proboscis is hinged above near the dorsal posterior end of the anteclypeus, *ac* of Fig. 4, B, and is received into the subcranial cavity of the head (which is usually rather inappropriately called the "oral" cavity—although the true oral cavity is a wholly different region, for the ingestion of food). The basal region of the proboscis is protruded largely by the pressure of the distended air sacs, which collapse to make room for the fulcrum, *fu*, (Fig. 4, B), when this portion of the proboscis is retracted. The action of the muscles which protrude the "oral cone" is described by Graham-Smith (1930), Weber (1933) and others.

The median portion of the proboscis, *mpr*, extends from the tip of the "oral cone" to the labella, and is called the haustellum, or mediproboscis. This portion of the proboscis belongs wholly to the labium, and includes the prementum, *pm*, posteriorly, while its anterior portion contains the labial gutter, or trough, in which the labrum and hypopharynx usually lie. It folds up against the basal portion of the proboscis when the latter is withdrawn into the subcranial, or "oral" cavity. The muscles operating this portion of the proboscis are likewise described by Weber (1933), Graham-Smith (1930), etc.

The distal portion of the proboscis, called the distiproboscis, is composed of the labella, *la*, or oral lobes. These are dilated by blood pressure, and are operated by various small muscles attached to the labellar sclerites, etc., which bring about the complicated movements

of the labella described by Graham-Smith (1930) in the feeding operations of the blowfly *Calliphora*.

In the "non-feeding position" of the labella of *Calliphora*, the oral or pseudotracheal surfaces of the labella are apposed to each other, and the posterior ends of the labella lie back against the mediproboscis in repose. In what Graham-Smith calls the "filtering position", the labella of the blowfly are opened out to form a flat, oral disk; and the pseudotracheal surfaces of the labella are applied to the food dissolved in the fluids regurgitated from the proboscis, so as to take up the fluid through the interbifid spaces, and strain out the particles which cannot pass through the filter apparatus. In what he calls the "cupping position", the outer edges of the oral disk, formed by the labella, are turned down to form a marginal rim around the now concave disk, which forms a cupping apparatus. In the so-called "intermediate position", the labella are separated sufficiently to partially expose the prestomal teeth and enable them to participate, to some extent, in the operations of the labella as they sponge up the fluid food through the filter apparatus; while in the so-called "scraping position", the labella are everted sufficiently to completely expose the prestomal teeth, which are brought into play to scrape, or rasp, the food substances. In the "direct feeding position", the labella are everted and drawn back against the mediproboscis, out of the way of the tip of the food channel, through whose orifice the liquids, and small particles contained in them, can pass directly into the food channel formed by the labrum and hypopharynx (Fig. 4, E and F).

The mouth parts of the muscoid type of fly described above belong to the absorbent, or sponging type (according to Metcalf and Flint, 1932), in which the labella are fleshy lobes, unfitted for piercing. In this type of mouth parts (Fig. 4, E and J), liquids entering the pseudotracheae, probably by capillary attraction, pass into the tracheal trunks, or collecting channels, and through the prestomum, or "oral" aperture, into the food channel (called the food meatus by Snodgrass, 1935) formed by the labrum, *lr*, and the hypopharynx, *hp*, shown in Fig. 4, F. Radial muscles, extending between the epipharyngeal and anterior labral walls, may possibly serve to dilate the lumen of the food channel, and aid in taking up the liquids into this region.

From the food channel, the liquid food is drawn up into the chamber of the first food pump, or fulcral pump, located in the floor of the fulcrum, *fu* of Fig. 4, E. This fulcral pump (referred to as the basipharynx by Peterson (1916), or the cibarium by Snodgrass (1935), etc.) is formed by a double, or false, floor in the interior of the fulcrum, *fu*, whose firm outer wall, *v* of Fig. 4, E, forms the floor of the pump chamber, while the pliable "false floor", *d*, forms the roof of the pump chamber. Muscles extending from the pliable roof of the chamber *d* to the anteclypeus, *ac*, etc., contract, and dilate the lumen of the pump, to suck up the liquid food. When these muscles relax, the liquids are compressed and forced back into the alimentary tube behind the fulcrum. In the housefly, regurgitation into the food

channel may be prevented by a chitinous, valvular projection near the entrance into the fulcral pump chamber.

In the Nematocera, and certain leptids, tabanids, therevids and asilids, a second food pump (called the oesophageal pump by Peterson, 1916, or the postpharynx by Patton and Evans, 1929, etc.) occurs just caudad of the fulcral region. Possibly this pump developed first, and was later supplanted by the fulcral pump.

Piercing or vulnerant mouth parts (as contrasted with the sponging type, etc.) are of two principal types in the Diptera. In one type of vulnerant mouth parts, which may be referred to as the "styletovulnerant" type (since the stylet-like mandibles, maxillary galeae, etc., are the principal piercing organs), the labium does not pierce, or enter the wound. Mouth parts of this type occur in such Nematocera as the phlebotomine Psychodidae, the Ceratopogonidae, Simuliidae, Culicidae, etc., and in the Tabanidae, certain Leptidae (*Symphoromyia*, etc.) etc., among the Orthorrhapha Brachycera. In a second type of piercing or vulnerant mouth parts, which may be referred to as the "labiovulnerant" type (since the labium is the principal piercing organ), the labium enters the wound—largely through the action of the prestomal teeth. This type is largely confined to the Cyclorrhapha, and occurs in the stable fly, tsetse flies, etc.

Some Nematocera, such as the Blepharoceridae, which attack other insects, might be included in the "styletovulnerant" type mentioned above, and certain empids, asilids,* etc., among the higher Diptera have the mouth parts modified in adaptation to their predaceous habits, but these types need not be further discussed here, since their mouth parts have been described in the general work on dipterous mouth parts by Peterson (1916). It may be worth while, however, to discuss very briefly a few of the most important representatives of the two types of insects with piercing mouth parts mentioned above.

In the mosquito type (Fig. 4, L and Fig. 3, E), the labium, *li*, forms a trough in which the other mouth parts, with the exception of the maxillary palpi, lie. The sides of the labrum curve downward, and their inflexed edges are approximated ventro-mesally to form the food channel (which is formed by the labrum alone). The hypopharynx, *hp*, which is traversed by the salivary canal, is situated below the labrum, and is received in a trough formed by the maxillary galeae, *g*, while the mandibles, *md*, lie along the sides of the labrum, *lr*, above them. When the female mosquito prepares to puncture the skin, the labella, *la*, of Fig. 3, E, are closely applied to it, and the maxillary galeae, *g*, are the structures chiefly involved in opening the wound, into which the other mouth parts are thrust, extending between the labella, *la*, which serve to guide the parts protruding between them. The labium does not enter the wound, but is bent backward (or bowed) as the other mouth parts sink into the skin.

In the tabanid type shown in Fig. 4, G, the labium, which forms a trough in which the other mouth parts lie, has been omitted from the figure. The top and sides of the food channel are formed by the labrum, *lr*, and the floor of the food channel is formed by the over-

*The hypopharynx apparently forms the principal piercing organ in the Asilidae.

lapping mandibles, *md*, which intervene between the labrum, *lr*, and the hypopharynx, *hp*, so that the hypopharynx (which is pierced by the salivary canal) does not form the floor of the food channel—as it frequently does in other Diptera. The overlapping mandibles also intervene between the labrum and the hypopharynx, in the resting position, in the Ceratopogonidae (*Culicoides*) and Simuliidae, which, however, are only distantly related to the Tabanidae. The galeae, *g*, of *Tabanus* (Fig. 4, G) form a trough in which the hypopharynx, *hp*, lies, and all of these mouth parts, excepting the maxillary palpi, lie in the labial gutter, or trough of the labium (which is not shown in Fig. 4, G). When a female tabanid prepares to puncture the skin, the labellar lobes are drawn back so as to expose the maxillae and mandibles, which are forced into the wound when the insect bends its head, and, by rapidly repeated movements, they extend the puncture into the blood-containing tissues. The lobe-like labella (which cannot puncture the skin) are provided with pseudotracheae into which the blood enters, and passing into the collecting channels, is carried through the "oral aperture" into the food channel, from which it is sucked up into the fulcral pump, or first food pump. A second food pump (called the "oesophageal" pump by Peterson, 1916) takes up the blood from the first pump, and passes it on into the so-called oesophagus, etc. (Two somewhat similar food pumps likewise occur in mosquitoes.)

In the blood-sucking Muscoidea (*sensu lato*), such as the stable fly, tsetse flies, etc., the proboscis is made up of the same parts as those found in the non-bloodsucking muscoids,* so that the diagram shown in Fig. 4, F, would serve equally well to illustrate the general relations of the mouth parts in either type of fly. In the Muscoidea the mandibles are atrophied, and the maxillary galeae usually become vestigial, while the distal parts of the labium become of increasing importance for taking up the food. The labella, which are provided with pseudotracheae, prestomal teeth, etc., in the typical muscoid flies, play a leading role in the feeding operations of these flies; and when the labella are reduced (and hardened) so that they will not impede the piercing operations of the labium in the blook-sucking flies, the prestomal teeth and interdental armature, borne on the labella, are developed for cutting into the skin, and largely serve to draw the labium into the wound. In the blood-sucking Muscoidea, as well as the non-bloodsucking ones, the food channel is formed by the labrum and hypopharynx (which is pierced by the salivary canal), the roof and sides of the food canal being formed by the labrum, *lr* of Fig. 4, F, while the floor of the food canal is formed by the hypopharynx, *hp*. The first food pump (or fulcral pump) is well developed in these flies, in which the second food pump (called the "oesophageal" pump by Peterson, 1916) is not developed.

In the Nycteribiidae (Fig. 7, B), the slender portion of the proboscis beyond the bulbous region of the haustellum is formed by the elongated labella (according to the later interpretations of Jobling

*It is quite probable that piercing mouth parts arose independently in certain types of blood-sucking flies among the higher Diptera.

(1929, p. 434)—which differ from his earlier views on the subject). The labrum, which usually forms the top and sides of the food channel, is quite short and extends forward only as far as the middle of the bulbous basal portion of the proboscis, so that the food channel, from this point onward, is formed by the upturned walls of the labial gutter, which is continued into the narrower, anterior portion of the proboscis formed by the labella. A cross section through the middle of the proboscis (Fig. 4, C) would therefore show the food channel, *fc*, formed by the walls of the labial gutter, *lt*, with the hypopharynx, *hp*, (pierced by the salivary canal), which is also enclosed by the walls of the labial gutter, situated above the food canal, *fc*, instead of forming the floor of the food canal, as the hypopharynx does when the roof of the food canal is formed by the labrum in the muscoid flies, etc. (Fig. 4, F). The elongated labella bear chitinized teeth, which apparently aid in the piercing operations of the proboscis.

In the Streblidae the labial gutter is well developed, and extends through the middle portion of the haustellum, into the labella. The walls of the labial gutter project mesally under the hinder portion of the hypopharynx, and interlock in such a way as to divide the labial gutter into a dorsal canal, which serves as a salivary canal, and a ventral canal, which serves as a food channel. The labella are armed with well developed teeth, which serve to penetrate the flesh when the proboscis pierces a wound; and Jobling (1929, p. 437) states that in the peculiar streblid *Ascodipteron* "the teeth of the serrated ridges of the labella in the female are enormously developed and serve to pierce the skin as well as to drag the insect into the wound, where it becomes encysted after shedding the legs and wings."

Morphology of the Thorax and Its Appendages

The best description of the thoracic and basal abdominal sclerites of the Diptera is that of Young (1921), who has described these parts in practically all of the dipterous families. Young's studies are supplemented by the papers of Crampton (1925-1926) on the thoracic sclerites of the nematocerous Diptera. Figures of the thoracic structures of the Diptera in general are given in the discussions of the parts by Hendel (1928), Patton and Cragg (1913), Walton (1909), Brauer (1882), Snodgrass (1909 and 1935), Martin (1916), Crampton (1926), and others, while the thoracic sclerites of individual Diptera are figured in the works of Kuenckel d'Herculais (1875), Hammond (1881), Lowne (1890), Ritter (1911), Hewitt (1914), Parker (1914), Prashad (1918), Bromley (1926), Balfour-Browne (1932), and Rees and Ferris (1939).

Grimshaw (1905), de Meijere (1901), West (1861), Crampton (1923), Crampton and Hasey (1915), Walton (1909), Hendel (1928), and Holway (1935) etc., have discussed the structure of the legs of Diptera, while Comstock, in his "Introduction to Entomology," and in his "Wings of Insects," has figured the venation of the wings in most of the families of the Diptera; and figures of dipterous wings are to be found in the works of Verrall (1901-1909), Williston (1908),

Hendel (1928), Curran (1934), and others. Tillyard (1919) has greatly modified Comstock's interpretation of the dipterous venation, and further modifications proposed by Alexander (1927-1929), Hendel (1928), Vignon (1932), and others have almost completely changed Comstock's original interpretation of the venation in the Diptera.

The embryological development of the Diptera (like that of all other insects as well) indicates very clearly that there are only three segments in the dipterous thorax (i. e., the pro-, meso- and metathorax); and until it can be proven that the thorax is composed of more than three segments in the embryonic stages, it is futile to speculate concerning the supposed occurrence of additional segments in the thorax of adult Diptera and other insects, as is done by Feuerborn (1925) and others. A comparison of the thoracic sclerites of the Diptera with those of a series of more primitive forms leading back through the Mecoptera, and nemopterid Neuroptera, to the Sialidae, and through these to the Isoptera, Plecoptera, and other orthopteroid insects, very readily reveals the purely secondary character of the various grooves, etc., which have been interpreted as marking off an intercalary segment in the Psychodidae, and other Diptera, by Feuerborn.

The prothorax and metathorax are extremely reduced in the Diptera, while the mesothorax is enormously enlarged to accommodate the powerful muscles of flight operating the mesothoracic wings, which are the only functional ones, the metathoracic wings having been modified to form the halteres (which are still wing-like in certain mutants of *Drosophila*). The displacement and distortion of the parts (due to the unequal development of the thoracic segments), and the formation of new sutures, and the re-combination of certain sclerites, make it very difficult to interpret the sclerites in some instances; but the use of certain more or less fixed features may be of value for determining the location, and extent, of some of the regions of the thorax.

1. Landmarks of the thoracic region

The position of the spiracles (which arise in the anterior region of the mesothorax and metathorax in the embryonic stages) is a feature of some value for determining the posterior extent of the pronotum, *ppn*, which extends posteriorly to the mesothoracic spiracle, *sp*, (located just behind the sclerite labelled *ppn* in Fig. 6, A, C, E, etc.), and for determining the anterior limits of the metapleuron, which extends forward to the general region of the metathoracic spiracle, *sp*, (situated anteroventrad of the base of the halter, *h*).

The region of the attachment of the wing (which indicates the line of division between the tergum and pleuron), and the region of the attachment of the leg, are features of importance for indicating the course of the pleural suture, *ps* of Fig. 6, A, C, etc., which extends between the episternum and epimeron, from the dorsal articulation of the coxa, *cx*, to the pleural fulcrum of the wing (above the sclerite labelled *sf*), no matter how much it may be distorted by the

displacement of the sclerites, forcing it to follow a zigzag course in the higher Diptera. The suture extending upward from the dorsal articulation of the prothoracic, or metathoracic coxa, marks the division of the pleuron of these segments into an episternal and epimeral region, so that the dorsal articulation of the coxa is of value for determining the anterior extent of the epimeral region when the epimeron is not clearly differentiated.

The halter is attached to the lateral margin of the metanotum, and its basal attachment is therefore of value for indicating the position of the metanotum when this region is greatly reduced. The small sclerites labelled *aba* in Fig. 6, A, C and E, are situated at each end of the transverse suture, *ts*, and in most instances serve to indicate the position of the suture even when it shifts about so greatly that it might be mistaken for some other suture. The significance of the other landmarks of the thorax will be discussed later

2. The neck

The cervix, or neck region (Fig. 6, A, B, C, D, etc.), is largely formed as a modified anterior portion of the prothorax (a portion of the labial segment may form a certain of the neck plates, also) situated between the head and the more strongly sclerotized region of the prothorax. The flexible membranous walls of the neck permit considerable freedom of movement of the head, while the cervical sclerites, or cervicalia, embedded in the membranous walls of the neck, serve to support the head, and furnish points of attachment for certain muscles extending to the head region.

Loew (1862) calls the neck the "collum", and applies the designation "cervix" to the postero-dorsal region of the head, corresponding to the region called the cerebrale by other dipterists. Coleopterists likewise apply the designation "cervix" to the postero-dorsal region of the head in beetles; and the membranous neck region behind the head is sometimes referred to as the eucervix, in order to avoid confusion in the application of the term cervix. Modern investigators, however, usually restrict the designation "cervix" to the neck region, behind the head, and this usage will doubtless become the generally accepted one.

The lateral cervical sclerites, or laterocervicalia, *lc* of Fig. 6, are the large lateral plates of the neck, which send forward a slender, anterior head-bearing process, or cephaliger, *cg*, articulating with the occipital condyles, and furnishing supports for the head. The lateral cervical sclerites are the principal plates of the neck region, and are greatly elongated in some tanyderids and tipulids. Each of the lateral neck plates, *lc* of Fig. 6, D, may send downward a medio-ventral extension, which joins a similar extension from the opposite side of the neck, in the mid-ventral region; and since such medio-ventral prolongations of the lateral neck plates occur in the simuliids, chironomids, dixids, corethrids, and culicids, this feature may be of some phylogenetic significance, since these insects are undoubtedly very closely related.

Small, anterior, lateral cervical sclerites, *al* of Fig. 6, A and B, occur in some tipulids, mycetophilids, etc., but they are always small and unimportant. The posterior lateral cervical sclerites, labelled *pl* in Fig. 6, B and C, are of more general occurrence, and are found in some Cyclorrhapha, stratiomyids, tabanids, anisopodids, bibionids, mycetophilids, etc. The sclerite, *pl*, may be free, as in Fig. 6, C, or it may be attached to the anterior margin of the propleuron, as in Fig. 6, B. The presternum, *prs* of Fig. 6, C, forms a ventral cervical sclerite in certain Cyclorrhapha, but it is usually absent in the lower Diptera.

In some cases, the character of the neck plates is of considerable value for indicating the relationships of the members of the tribes or subtribes of the families of lower Diptera. Thus, the shape of the lateral cervical sclerites is a feature of considerable importance for distinguishing the members of the subtribe Eriopteraria from the members of the subtribe Claduraria, in the eriopterine tipulids (Crampton, 1925); and it is possible that these structures may prove to be of value in other families of Diptera.

3. The prothorax

The prothorax is greatly reduced in the Diptera; and the posterior region of the pronotum exhibits a marked tendency to unite with the mesonotum in the higher Diptera—as is also the case in the higher Hymenoptera. The dorsal and lateral regions of the prothorax are quite closely united in the Diptera in general, but the sternal region usually remains separated from the pleural region in the lower Diptera. In certain Mycetophilidae, Bibionidae, Stratiomyidae and Tabanidae, however, the principal sternal sclerite, or basisternum, *bs* (Fig. 6, B), is connected with the episternum, *es*, by a pre-coxal bridge, *pc*, or sclerotized band extending in front of the coxa, *cx*, from the sternal to the pleural region of the prothorax; and the arch formed in this fashion probably gives added rigidity to the sclerites which it connects.

The Pronotum. The pronotum of the Diptera, like that of certain Hymenoptera and Mecoptera, is divided into an anterior region, or antepronotum, *apn*, and a posterior region, or postpronotum, *ppn* (Fig. 6, A, B, C, D and E). The antepronotum, *apn*, is best developed in the tanyderids, certain tipulids, etc., but it tends to become much reduced in the higher Diptera, in which the postpronotum, *ppn* (Fig. 6, C) increases in size, and becomes closely united with the mesonotum (Fig. 6, E). The postpronotum, *ppn* of Fig. 6, C, is usually referred to as the humerus, or the humeral callus of the "mesonotum" in the higher Diptera, although Hammond (1881) long ago pointed out that in the blowfly the muscles attached to the "humeral callus" are prothoracic, not mesothoracic. The postpronotum, *ppn* of Fig. 6, D, is usually incorrectly called the prothoracic "epimeron" in mosquitoes (see Freeborn, 1924). In the sheep tick (Fig. 6, F) the pronotum becomes indistinguishably united with the

mesonotum; but the position of the mesothoracic, or anteriormost spiracle, *sp*, indicates that the region immediately in front of it belongs to the pronotum, *ppn* of Fig. 6, E.

The Propleuron. The pronotum is rather closely united with the pleural region in most Diptera (Fig. 6, A and B), and the transverse dividing line between the antepronotum, *apn*, and postpronotum, *ppn*, (which corresponds in a general way to the transverse suture of the mesonotum), is continued downward, on each side, in the pleural suture between the episternum, *es*, and the epimeron, *em*.

A small incision separates the prothoracic episternum, *es*, from the pronotum above it, in some tipulids (Fig. 6, A), and a rather faint suture is formed in the general region of this incision in a few Diptera, but in most cases the episternum merges with the pronotal region above it. In the lower Diptera (Fig. 6, A and B) the prothoracic epimeron, *em*, is broader than the postpronotal region immediately above it, and is distinct from the episternal region of the mesothorax behind it. It sometimes forms an arch over the base of the coxa, extending from the coxal process, *cf*, to the mesothoracic episternum. In the higher Diptera (Fig. 6, C and E) the prothoracic epimeron, *em*, becomes closely united with the episternal region of the mesothorax, and may merge with the latter more or less completely.

The coxifer, *cf*, or ventral process of the pleural region forming the dorsal pivot of the coxa, *cx*, is formed by a ventral prolongation of the parts of the episternum and epimeron adjacent to the pleural suture (Fig. 6, C and D). In the winged hippoboscids (Fig. 6, E), the coxifer, *cf*, is well developed, and becomes of considerable importance in the movements of the legs of the wingless forms, such as the sheep tick shown in Fig. 6, F.

The Prosternum. Four sternal sclerites occur in the prothorax of some orthopteroid insects. The anteriormost sclerite, called the presternum, is probably a detached portion of the basisternum behind it. The second sclerite is called the basisternum, or sternum proper, and is frequently connected with the pleural region by a pre-coxal bridge (the occurrence of this bridge is used by Malloch and others in classifying the asilids). The third sclerite, called the furcasternum or "sternellum", bears the furca, or internal paired apophyses for muscle attachment, and probably arose as a demarked posterior region of the plate whose anterior region formed the basisternum. The fourth sclerite, called the spinasternum or "poststernellum", bears the spina, or unpaired, internal, median apophysis for muscle attachment. The spinasternum probably arose as a distinct sclerite, although Snodgrass considers that it represents a detached portion of the sternal region behind it.

The sclerite labelled *prs* in Fig. 6, C, of the housefly represents the presternum of the lower insects, although this sclerite is absent in most of the lower Diptera. The basisternum, *bs*, is not connected with the pleural region in the tipulid or the muscid shown in Fig. 6, A and C, but in the mycetophilid and culicid shown in Fig. 6, B

and D, a pre-coxal bridge, *pc*, extends in front of the coxa, from the basisternum, *bs*, to the episternum, *es*. The furcasternum, or "sternellum", is represented by the region labelled *fs* in the hippoboscid shown in Fig. 6, E, but the fourth sternal sclerite, or spinasternum, is not represented by a distinct area in typical Diptera. A description of the sternal sclerites of the prothoracic region of such Diptera as *Hippobosca*, *Mydas*, *Tabanus*, *Anisopus*, *Johannsenomyia* and *Limnophila*, is given in a paper by Crampton (1926), in which these sclerites are compared throughout the orders of insects; and, as is pointed out in the paper in question, the character of the sternal sclerites furnishes some very conclusive evidence that the Diptera were descended from ancestors extremely closely related to the Mecoptera.

4. The mesothorax

The enlargement of the mesothorax is accompanied by a lengthening and uparching of the mesonotum, which affect the upper region of the pleuron as well, resulting in the displacement, and distortion, of the dorsal plates of the pleuron in the higher Diptera. As the mesothorax develops at the expense of the metathorax, the reduced metanotum shrinks away from the posterior region of the mesonotum and exposes the postscutellum, which becomes a prominent feature of the dorsal region, as it does in the neuropterous family Nemopteridae, in which the metathorax and hind wing are reduced in a fashion somewhat suggestive of the precursors of the Diptera (see Fig. 10, Plate 21 of paper by Crampton, 1931). The sternal region is not so much affected by the distorting process as the other parts are, although it is considerably affected by the modifications of the middle coxae, since the sternum is folded together between them, when the coxae become approximated in the mid-ventral region of the body, and the lateral wings of the sternum extend along the mesal surfaces of the coxae to furnish the ventral pivotal points of the coxae in certain Diptera.

The Mesonotum. The notum, or tergum, of any segment includes the entire dorsal region of the segment (from the ridge of one phragma to the ridge of the following one), and the designation mesonotum should therefore indicate the entire dorsal region of the mesothorax (from the anterior margin of the prescutum to the posterior margin of the postscutellum), rather than the small portion of the true mesonotum to which the designation is applied in the Diptera. As is the case in the wing-bearing segments of other insects, the mesonotum of the Diptera contains an anterior wing-bearing plate, or eunotum ("alinotum" of Snodgrass, 1935), and a posterior plate behind the wing, called the postnotum (or postscutellum, *psl* of Fig. 6, A. The anterior, wing-bearing plate becomes marked off into three principal areas (Fig. 6, C) called the prescutum, *psc*, scutum, *sc*, and scutellum, *sl*, while the postscutellum or postnotum, *psl*, forms a fourth sclerite of the dorsal series, although it has a different origin from that of the first three subdivisions of the wing-bearing plate.

Transverse, internal, shelf-like projections, called phragmas, furnish points of attachment for the longitudinal dorsal muscles which arch the notum in the movements of flight, and their ventral ridges mark the anterior and posterior limits of the segments, in the dorsal region of the segments of insects in general. The postscutellum of the mesothorax bears a large, well-developed phragma (called the postphragma), to which are attached certain of the longitudinal muscles extending to the prescutal region of the notum. The phragma borne on the anterior region of the prescutum (called the prephragma) is greatly reduced in the Diptera. Other names are sometimes applied to these phragmas, but since they are internal structures, they are of little interest to taxonomists, and are but seldom referred to by dipterists in general.

The sclerite called the prescutum in the Diptera (i. e., *psc* of Fig. 6, C) is not exactly homologous with the sclerite designated as the prescutum in the Hymenoptera, etc., since the true prescutum is the region labelled *psc* in Fig. 6, A, to which are attached the dorsal longitudinal muscles extending to the postscutellum; and the prescutal suture (notaulices of Hymenoptera), demarking the true prescutum, is either reduced to the small remnant labelled *pss* in Fig. 6, B, or is completely obliterated in most Diptera. This vestige of the prescutal suture is sometimes called the "pseudosuture"; and the prescutal pits, *psp* of Fig. 6, A, which are called the pseudosutural foveae or humeral pits, indicate the true position of the prescutal suture formerly occurring in this region (but later lost in typical Diptera). These pseudosutural foveae, and the paired dots (one on each side of the mid-dorsal line) occurring in the anterior region of the prescutum, and called the tuberculate pits, are features of some importance in the classification of the Tipulidae. The character of the narrow, marginal sclerite, *pat* of Fig. 6, A, called the paratergite, is also a feature of some value in the classification of the Tipulidae.

In the Hymenoptera the so-called transscutal suture, or cleft, divides the scutum into an anterior and posterior region; and in the Diptera the corresponding suture, *ts* of Fig. 6, A, C and E, is called the transverse suture. The transverse suture may be incomplete in some Diptera, while in the Tipulidae it forms the so-called V-shaped suture, *ts* of Fig. 6, A. The anterior region of the scutum, *asc* of Fig. 6, A, lying in front of the transverse suture, *ts*, merges with the true prescutal region, *psc* of Fig. 6, A, to form a composite area which is usually called the "prescutum" in the Diptera (i. e., *psc* of Fig. 6, C and E), and although this region is a pseudoprescutum not strictly homologous with the true prescutum of other insects, there is no serious objection to applying this designation to it in the Diptera, for the sake of convenience.

The notopleural region, labelled *npl* in Fig. 6, C, forms a sunken area sometimes called the presutural or sutural depression in the muscoid Diptera, in which the area in question may bear the so-called notopleural bristles. The cleft, or suture, just below the label, *npl* in Fig. 6, C, extending from the humeral callus or postpronotum, *ppn*,

to the base of the wing, is called the dorsopleural or notopleural suture.

The scutum, according to the dipterists, is the area, *sc*, behind the transverse suture, *ts* of Fig. 6, C, but this region is not the entire scutum, since the anterior region of the scutum, *asc* of Fig. 6, A, combines with the true prescutum, *psc* of Fig. 6, A, to form the so-called prescutum, *psc* of Fig. 6, C, as was mentioned above. It should therefore be understood that the region labelled *pos* in Fig. 6, A, or that labelled *sc* in Fig. 6, C and E, is in reality only the posterior portion of the entire scutum, and is referred to as the "scutum" merely for convenience, in order to avoid further increasing an already very extensive terminology for the external morphology of the Diptera.

The parascutellum, *pas* of Fig. 6, C, and of Fig. 7, I, is an area of the scutum lying on each side of the scutellum, *sl*. Its surface is usually somewhat declivitous, and in some Diptera it forms a trough-like area on each side of the scutellum. It comprises a fairly large area in the higher Diptera (Fig. 6, C) but is greatly reduced in those insects in which the scutellum is small (Fig. 6, D).

The scutum bears the dorsal wing processes, or dorsal pivotal points involved in the movements of flight. The anterior wing process is formed by the suralar sclerite, labelled *sra* in Fig. 7, I, while the posterior wing process is formed by the so-called adanal process, labelled *anp* in Fig. 7, I. The axillary sclerites, referred to later, are situated between the bases of the wing-veins and these processes of the scutum.

The following designations are applied to certain features of the scutum by writers on chaetotaxy. The small ridge on each side of the scutellum, connecting it with the scutum, is called the scutellar bridge. The swollen, antero-lateral area of the scutum, lying just behind the lateral ends of the transverse suture, and antero-mesad of the bases of the wings, is called the prealar callus; while the postalar callus is a tubercle between the scutellum and the wing, which, according to Imms (1929), "constitutes the prominent posterodorsal angle of the scutum." The supraalar groove or cavity is the lateral groove extending along the scutum immediately above the attachment of the wing; while the alar frenum, according to Comstock (1924), is "a little ligament dividing the supraalar cavity into an anterior and posterior part."

The scutellum, *sl*, is the posteriormost, median sclerite of the wing-bearing plate; and according to some entomologists, the scutellum includes not only the median region labelled *sl* in Fig. 6, but also the lateral region, *pas*, as well. It is preferable, however, to restrict the designation scutellum to the median region, *sl*, alone. There is usually an anterior and a posterior ridge on each side of the scutellum, to give it more rigidity; and the parascutellum lies between these two ridges, adjacent to the scutellum. The posterior ridge usually forks a short distance from the edge of the scutellum, and the anterior arm becomes folded over forward, while the posterior arm follows the posterior margin of the wing-bearing plate, which is

continued in the posterior margin of the wing (as the so-called axillary cord).

Two extremely interesting modifications of the scutellum are shown in Fig. 7, A and C. In the South American stratiomyid *Dicranophora furcifera* (Fig. 7, C), the scutellum, *sl*, is prolonged over the top of the abdomen as a slender forked process extending almost to the tip of the abdomen; and in other stratiomyids, diopsids, etc., the scutellum bears long pointed spines and similar processes. The most amazing modification of the scutellum, however, is exhibited by the lauxaniid (or celyphid) fly, *Celyphus obtectus*, shown in Fig. 7, A, in which the broad, hemispherical scutellum, *sl*, extends over, and largely conceals the abdomen, giving these flies somewhat the appearance of tortoise beetles, or scutellerid Hemiptera; and this resemblance is sometimes heightened by a gleaming iridescence of the entire thoracic region.

The postscutellum, or postnotum, *psl* of Fig. 6, is the posteriormost plate of the notum. It is hugely developed in most of the lower Diptera, but in some of the higher Diptera, such as the tabanids, sheep ticks (Fig. 6, F), etc., its external surface is considerably reduced, although the internal phragma, or postphragma, which it bears (i. e., the internal, transverse, shelf-like structure for muscle attachment), is greatly developed in the tabanids, and forms one of the most conspicuous internal features of these insects.

The postscutellum, or postnotum, *psl*, is divided into a median region or mediotergite, *mt*, (Fig. 6), and two lateral regions (one on each side) called the pleurotergites, *ptg*, which form the postalar arches, or bridges connecting the median region of the postscutellum with the epimeral region of the pleuron. The pleurotergite is frequently subdivided into an upper and lower region known as the superior and inferior pleurotergite, *spt* and *ipt* of Fig. 6, A and C, which are called the anapleurotergite and katapleurotergite by Young (1921). These designations are somewhat long and cumbersome, and might be shortened to "anatergite" and "katatergite" if it is desirable to designate the regions in question by a single term. These areas are of some importance in the classification of the Tipulidae, etc.

The subscutellum, *ssl* of Fig. 6, C, is an area of the mediotergite, *mt*, (a median region of the postscutellum) situated immediately below the scutellum, *sl*. It is usually concave in the muscoid flies, but, as is pointed out by Malloch and others, it becomes strongly convex in the tachinids, and is a character of considerable importance for distinguishing them from most of the muscoid flies. Curran (1924, p. 167) calls attention to the occurrence of this sclerite in the Stratiomyidae, Syrphidae and Tachinidae (including the Dexiidae) and stresses its importance as an indication of the fact that the syrphids and tachinids may have descended from the Stratiomyidae. There is a very strong possibility, however, that the syrphids, etc., were descended from ancestors like the bombyliids and nemestrinids, which, with the mydaids, asilids, etc., appear to lead back to a therevid ancestry (rather than a stratiomyid ancestry), and too much weight should

not be given to the occurrence of this small area in the postscutellum. Curran (1924) proposes the name "metascutellum" for the mesothoracic subscutellum, *ssl* of Fig. 6, C, but the true metascutellum is the scutellum of the metathorax, which is an area of the metanotum; and from the morphological standpoint, it is inadvisable to apply the designation "metascutellum" to any structure other than the true scutellum of the metathorax, so that it is preferable to designate the sclerite below the mesoscutellum as the subscutellum.

It is very unfortunate that the erroneous interpretation of the parts of the mesothoracic postscutellum proposed more than a century ago by Westwood (1832) and others, became so firmly established in the literature that even the influence of Brauer (1882) was insufficient to cause it to be discarded; and many taxonomists still cling to the old familiar misinterpretations, despite the fact that students of comparative morphology in this country and abroad have repeatedly shown that these interpretations are wholly untenable. Westwood (1832) considered that the mesothoracic mediotergite, *mt* of Fig. 6, A, B, C, etc., is the scutum of the metathorax, and interpreted the metanotum, *mtn*, as the scutellum of the metathorax, although he rejected the idea proposed by Latreille (1821-1825) that the metathorax of the Diptera represents the median segment of the Hymenoptera (and that the halteres are abdominal appendages). Although he was acquainted with the observations of Hammond (1881), who had shown that the mediotergite, *mt* of Fig. 6, A, B, C, etc., is a part of the mesothoracic postscutellum, Osten-Sacken (1884) appears to adopt the designation "metanotum" for the mediotergite, *mt*, in his figures of the parts taken from the paper by Mik (1882) and designates the lateral portion of the mesothoracic postscutellum, labelled *spt* and *ipt* in Fig. 6, A, C, etc., as the "metapleura", which, he says, corresponds to the callus metanoti lateralis of Loew (1862).

Brauer (1882) calls the sclerite, *ssl* of Fig. 6, C, the "postscutellum", and interprets the sclerite, *mt*, as the mesophragma (i. e., the mesothoracic postphragma). He appears to think that the sclerite, *spt* of Fig. 6, A, is a portion of the mesothoracic epimeron, and suggests that the sclerite, *ipt*, may represent the metathoracic episternum, or even the prescutum of the metathorax. The lateral regions of the postscutellum (*ptg*, *spt* and *ipt* of Fig. 6), however, are recognized as such by all of the recent students of comparative morphology, such as Snodgrass (1909), Crampton* (1925-1926), Young (1921), Comstock (1924), Weber (1933), etc., who are unanimous in interpreting the sclerite, *psl*, as the mesothoracic postscutellum in the Diptera. Curran (1934), however, is evidently expressing the opinion of many of the taxonomists when he states, in a footnote to page 487, that he is "far from being convinced that the metanotum, as used by taxonomists is actually part of the mesonotum: there is a distinct,

*The development of ***Protoplasa*** (see Crampton, 1930, p. 88, and Plate 3) which is one of the most primitive representatives of the order Diptera, very clearly shows that the postscutellum develops from the mesothoracic region in front of the true metanotum, which bears the wing-like cases of the halteres in the pupa of this archaic form.

membranous suture between this part and the scutellum, such as one expects to find between true sclerites." The occurrence of such a suture between the wing-bearing plate and the postscutellum of the mesonotum, however, is merely to be expected, since the postscutellum arises as a distinct plate of this nature in insects in general, and the Diptera have merely followed the usual plan in preserving such a dividing line between the wing-bearing plate (eunotum) and the postscutellum, as may be seen by comparing the parts (and the muscles attached to them) in a series of insects including a plecopteron, a neuropteron of the family Nemopteridae, a mecopteron such as *Bittacus*, and a primitive dipteran such as a tipulid, etc. (See figures by Crampton, 1931.)

The remarkable similarity between the sclerites of the mesonotum of such Diptera as the Tipulidae and the sclerites of the mesonotum of the mecopteron *Bittacus* may be seen by comparing Fig. 6 (of *Tipula*) with Fig. 3 (of *Bittacus*) in Plate 2 of article by Crampton (1919). The character of the sclerites of the mesonotum of the neuropteron *Nemoptera* (shown in Fig. 5 of the same publication) lends further weight to the evidence from other sources indicating that this neuropteron has retained many features characteristic of the ancestors of the Mecoptera, etc., although *Nemoptera* itself has developed too many specializations of its own to occupy a position in the direct line of descent of the Mecoptera and Diptera.

The Mesopleuron. In many Nematocera, the pleural suture, *ps* of Fig. 6, A and D, dividing the episternal region from the epimeron, extends as a rather straight line (or one without very sharp curves) from the dorsal articulation of the coxa, *ec*, to the alifer, or pleural fulcrum of the wing. The pleural suture, *ps*, is not straight in the mycetophilid shown in Fig. 6, B, however, and in the bibionid *Aspistes berolinensis* (Crampton, 1925b, Pl. 6, Fig. 28) it is markedly bent, and follows a zigzag course as in the higher Diptera, so that the pleural suture is not straight in all of the Nematocera. In the Orthorrhapha Brachycera and the Cyclorrhapha, it becomes increasingly bent, and follows a zigzag course, as is illustrated by the housefly shown in Fig. 6, C, in which the pleural suture, *ps*, bends sharply forward, and then sharply upward, at right angles to its former course, and finally bends slightly backward, as it ascends to the alifer, or pleural fulcrum of the wing, just above the sclerite labelled *sf* in Fig. 6, C.

In the tipulid shown in Fig. 6, A, the episternum is divided by the anepisternal suture, *as*, into an upper and lower region, called the anepisternum, *aes*, and katepisternum, *kes;* and the epimeral region is faintly divided into an upper and lower region, called the anepimeron, *aem*, and katepimeron, *kem*, in other insects, although different terms are applied to these sclerites in the Diptera. Thus, Osten-Sacken (1884) calls the sclerite, *aes* of Fig. 6, A, the "mesopleura" (a designation which should indicate both flanks or pleura of the mesothorax), and designates the sclerite *kes* as the sternopleura, while the region *aem* is termed the pteropleura, and the composite area composed of the sclerites *kem* and *me*, together with the meta-

pleuron, is called the hypopleura in his terminology. As he states (p. 498), this terminology is a purely conventional one which "offers more chance of fixity; it may very well exist alongside of a homological and anatomical terminology" which is "often subject to uncertainty and dispute." While this objection to applying a standard terminology to the thoracic sclerites of the Diptera may have been a valid one at that time, in the half century which has intervened, the homologies of the sclerites of the dipterous thorax have been established quite satisfactorily, and it is no longer necessary for dipterists to employ a terminology of their own (and differing from that used in the other orders of insects) in referring to the venation of the wings, or to the sclerites of the thorax.

The anepisternum, *aes* of Fig. 6, A, B and D (called the "mesopleura" by Osten-Sacken), is only the upper portion of the episternum, although it is usually interpreted as the entire episternum in the Diptera. It is separated from the mesonotum and the prothorax by a membranous area in many lower Diptera (Fig. 6, A and B), but in the higher Diptera (Fig. 6, C and E) it encroaches upon the membranous region above it as far as the dorsopleural or notopleural suture, and extends forward to the prothorax, with which it becomes rather closely united as far as the region of the anterior spiracle. Its posterior boundary is marked by the pleural suture, *ps*; and its ventral boundary is marked by the anepisternal or sternopleural suture, *as*.

In many of the Nematocera, such as the mycetophilid shown in Fig. 6, B, the anepisternum is divided, by a more or less vertical cleft, into an anterior and posterior anepisternum, *aae* and *pae*. In the culicids (Fig. 6, D), the dividing cleft extends as an oblique slash, which cuts off the anterior anepisternum, *aae*, which becomes stranded upon the prothorax (forming the so-called postspiracular area), while the posterior anepisternum, *pae*, remains united with the rest of the episternum, *es*, below it, and the suture between them becomes obliterated. In the muscoid Diptera (Fig. 6, C), the anterior anepisternum becomes greatly enlarged, and occupies most of the anepisternal region, while the posterior anepisternum is greatly reduced, and is rather closely associated with the upper region of the epimeron, *aem*. In the hippoboscid shown in Fig. 6, E, the anterior anepisternum merges with the rest of the episternum below it, when the suture between them becomes obliterated, and it is separated by a vertical cleft from the posterior anepisternum, which becomes closely associated with the upper region of the epimeron, *aem*. In the sheep tick shown in Fig. 6,F, these unions have become still more intimate, and the cleft which apparently divides the episternum, *es*, from the epimeron, *em*, is in reality the anepisternal cleft, dividing the anterior anepisternum (which unites with the rest of the episternum) from the posterior anepisternum (which unites with the epimeron). The region in front of the cleft likewise unites with the notum above, and with the prothorax anteriorly, forming supporting arches above the front and

middle coxae, and furnishing a solid connection with the sternal region as well.

The basalar sclerites (sometimes incorrectly called the "parapterа") are the small sclerites situated near the base of the wing, in the dorsal region of the anepisternum, *aes*. The posterior basalar sclerite is usually attached to the upper portion of the anepisternum, but the anterior basalar sclerite, *aba* of Fig. 6, A, C and E, is a small, separate plate, which is sometimes connected with the notum by a narrow strip (the prealar bridge), extending in front of the base of the wing, as is the case in the tipulid shown in Fig. 6, A. The basalar sclerites are located in front of the alifer, or pleural fulcrum of the wing, and the sclerite, *sf* of Fig. 6, C and E, is located immediately below the pleural fulcrum of the wing.

The katepisternum, or "sternopleura", *kes* of Fig. 6, A, B, and C, is the lower portion of the episternum, which is usually interpreted as the anterior region of the mesosternum in the Diptera. It is closely united with the sternal region, and when the sternal region becomes inrolled in the mid-ventral line (forming a median endosternal partition anterior to the base of the furca) the katepisternum may extend ventrad almost as far as the middle of the ventral region of the mesothorax.

In the culicids (Fig. 6, D) a sclerite, *ptn*, corresponding to the pleurotrochantin of other insects, occurs in the lower portion of the episternal region, and is overlapped by a fold of the integument above it. Young (1921) mistakes this sclerite for the combined meron and lower region of the epimeron (meropleurite), and interprets the mesothoracic meron, *me*, as the episternum of the metathorax in his figures of the thoracic sclerites of the culicids, although his interpretations of the dipterous thorax in other respects are usually quite accurate.

The anepimeron, or "pteropleura", *aem*, is rather faintly demarked from the rest of the epimeron in the tipulid shown in Fig. 6, A, but in most of the higher Diptera (Fig. 6, C), there is a distinct suture (the anepimeral suture) between it and the lower portion of the epimeron, which unites with the meral region to form the composite region labelled *mpl* in Fig. 6, C. The anepimeral region is divided into an anterior and posterior region by a vertical subalar suture, labelled *sas* in the mycetophilid shown in Fig. 6, B, but the anepimeral region is not demarked from the lower portion of the epimeron in this insect, or in the culicid shown in Fig. 6, D. An apodemal pit, however, occurs in the pleural suture, *ps*, just in front of the label *em* of Fig. 6, B, at the level of the suture which divides the epimeron into an upper and lower region in the higher Diptera.

A subalar plate, *sa*, frequently occurs in the subalar membrane between the insertion of the wing and the dorsal portion of the epimeral region. This plate is sometimes called the epimeral "parapteron", while Hewitt (1914) and Lowne (1890) call it the "costa" (a term usually applied to a vein of the wing). In some syrphids a

delicate structure called the plumule by Kuenckel d'Herculais (1875) is borne in this region of the thorax.

The katepimeron, or "hypopleura", *kem*, is faintly demarked from the upper region of the epimeron above it in the tipulid shown in Fig. 6, A, and the katepimeron is divided into an upper and lower region in this insect. The epimeron, *em*, is not divided into an upper and lower region in the culicids (Fig. 6, D), and there is no suture between the upper and lower portion of the epimeron in the mycetophilids (Fig. 6, B), but the lower portion of the epimeron is typically much narrower than the upper region in the mycetophilids. The katepimeron, *kem*, does not unite with the meron, *me*, in most of the tipulids (Fig. 6, A), but in the hexatomine and eriopterine tipulids (Crampton, 1925c, Plates 2 and 3), the genera *Neolimnophila*, *Crypteria*, *Ormosia*, *Helobia*, *Molophilus* and *Amphineurus* furnish an excellent series of intergradations in which the meron is quite distinct at first, but gradually becomes detached from the rest of the coxa, and migrates into the pleural region to fuse with the lower portion of the katepimeron, to form a composite region, such as that labelled *mpl* in Fig. 6, C, called the meropleurite or meropleuron. Hansen (1930) denies that such a fusion of the meron with the anepimeron occurs in the Diptera, but the muscles attached to the composite region bear out the evidence of comparative anatomy, which very clearly shows that such a fusion does occur; and a complete series of intergradations illustrating the steps in the process of fusion is to be found in several different types of Diptera, so that the tipulids mentioned above are not the only Diptera illustrating this process very convincingly to anyone who is at all familiar with the anatomy of these forms.

When the meral region of the coxa unites with the katepimeron, as in the housefly shown in Fig. 6, C, the remainder of the coxa may become divided into a basal region, *bcx*, which remains united with the region *mpl*, while the distal region, *dcx*, becomes detached to restore the mobility of the coxa when its basal region is united with the lower region of the epimeron. Malloch (1923), Shannon (1923), and others, have pointed out the value of the occurrence of the sclerite, *dcx*, (Fig. 6, C), or the process it bears, for indicating the relationships of the Pyrgotidae and other higher Diptera.

The mesothoracic meropleurite, *mpl* of Fig. 6, C, is usually interpreted as the "metasternum" in the Diptera, as is also the case with the meron, *me* of Fig. 6, A and D, although these sclerites are sometimes called the "episternum" of the metathorax. In other instances, the meropleurite, *mpl*, (or the meron, *me*) is regarded as the posterior region of the mesosternum, and in such cases the dorsal portion of the epimeron, *aem*, above it, is interpreted as the entire epimeron, and numerous other interpretations have been given for these and other sclerites of the thorax. The real homologies of the thoracic sclerites have been known for more than a quarter of a century, however, but taxonomists have been unwilling to give up the conventional terminology proposed by Osten-Sacken (1884) despite the fact that some of

his terms such as "mesopleura" and "metapleura" cannot be restricted to the parts so designated by him, and the area which he designates as the "hypopleura" is an unnatural conglomeration of parts of the mesothorax and metathorax, combined. An examination of the figure on page 503 of the paper by Osten-Sacken (1884)—which was taken from a figure by Mik (1882)—will show that what Osten-Sacken here calls the "hypopleura" is, in reality, the mesothoracic meropleurite, *mpl*, together with the metathoracic episternum, *es*, and epimeron, *em*, of Fig. 6, C (of the present paper); and this application of the term hypopleuron is adopted in the textbooks of Imms (1929, Fig. 565), Tillyard (1926, Fig. W 12), and others, although Aldrich and Darlington (1908) apply the term "hyposternum" to this area. Williston (1908, Fig. 8) and Verrall (1901, Fig. 122), on the other hand, restrict the term "hypopleura" to the metapleuron alone, while Comstock (1924) in his Fig. 1001 (taken from Riley and Johannsen) appears to use the designation "hypopleura" for the meropleurite of the mesothorax, although the metapleuron may possibly be included in Comstock's "hypopleura", since the limits of the area in question are not clearly defined. Back (1909) applies the designation "hypopleura" to the pleurotergite (i. e., the areas labelled *spt* and *ipt* in Fig. 6, C) in his Fig. 2 (Plate 2) of the thoracic sclerites of an asilid, and other taxonomists employ the term "hypopleura" in so many different ways that there is no uniformity of usage even when a purely conventional terminology of this kind is employed, and a more exact terminology based upon comparative morphology is much preferable to that suggested by Osten-Sacken, which has no significance from the latter standpoint.

The Mesosternum. The mesosternum is relatively small and unimportant in most Diptera. In the tipulid *Gnophomyia tristissima* (Crampton, 1925b, Plate 3, Fig. 8) the mesosternal region contains a presternum, basisternum, and furcasternum, with the latter divided into an anterior and posterior division by a transverse suture. The basisternal region, *bs* of Fig. 6, A and B, may be external, or it may become inrolled along the median ventral line to form an internal median partition in front of the furca, or paired apophysis of the sternal region. In such cases, the lower portion of the episternum, *kes* of Fig. 6, C, extends downward toward the mid-ventral region of the mesothorax.

The furcasternum (or sclerite bearing the furca) does not, as a rule, participate in the inrolling process, but frequently becomes folded between the coxae as these approach each other in the mid-ventral region. A wing-like lateral extension (one on each side) is frequently given off by the furcasternal region, and extends along the mesal surface of the middle coxae to furnish a ventral pivotal point for the coxae when the latter are mobile.

5. The metathorax

The metathorax of the Diptera was regarded as the representative of the median segment, or first abdominal segment of the Hymen-

optera, by Latreille (1821-1825) and other earlier investigators, such as Kirby and Spence (1826), etc., who interpreted the halteres as abdominal appendages, and suggested that the calypteres might represent the true hind wings of the Diptera. The fine investigations of Hammond (1881) and Brauer (1882) demonstrated the fallacy of this view, and likewise showed that the interpretations of Westwood (1832) and others who regarded the mesopostscutellum as the "metanotum", were incorrect. The scholarly work of Brauer, however, (which involved considerable knowledge of comparative morphology) was entirely ignored in favor of the apparently simple, but morphologically unnatural, division of the thorax into regions by Osten-Sacken (1884), and it is only in comparatively recent times that the real value of Brauer's morphological work has been properly appreciated.

The Metanotum. The metanotum of the Diptera, *mtn* of Fig. 6, A and B, is usually reduced to a narrow, transverse band extending behind the postscutellum, *psl*, from one halter to the other. It is best developed in the Psychodidae such as *Nemopalpus*, *Bruchomyia* and *Psychoda*, in which the pronotum is as greatly reduced as it is in any of the Diptera (see Crampton, 1926a, Plates 3 and 4). In the pupa of the primitive dipteran *Protoplasa* (Crampton, 1930, Plates 3 and 5), it may readily be seen that the true metanotum arises as it does in other insects, and bears the rather broad wing cases of the halteres.

The Metapleuron. The metapleuron is fairly large in the mycetophilids (Fig. 6, B) and culicids (Fig. 6, D) but is frequently greatly reduced in the higher Diptera (Fig. 6, E and F), and may be quite small even in such primitive Diptera as the tipulids (Fig. 6, A). The pleural suture, separating the episternum from the epimeron, extends from the coxal process (coxifer), *cf*, to the halter, whose position is indicated by the label *h* when the halter has been removed. The episternum, *es*, (Fig. 6, B and D) is usually somewhat broader than the epimeron, *em*, and the latter is sometimes rather closely associated with the first abdominal sclerites. In the tipulid shown in Fig. 6, A, the episternum is divided into an anepisternum, *aes*, and katepisternum, *kes*, as it is in the mesothorax.

The anterior extent of the metapleuron is indicated, in a general way, by the position of the spiracle, *sp* of Fig. 6, C and D (which is located in the anterior region of the metathorax in the embryo), so that the location of the spiracle, *sp*, may be taken as indicating the anterior limit of the metapleuron in such Diptera as the sheep tick shown in Fig. 6, F, in which the posterior portion of the thorax is greatly modified, and is rather closely united with the mesothorax, etc. The true metapleuron is usually included with the mesothoracic meropleurite, *mpl* of Fig. 6, C, in the region called the "hypopleura" by Osten-Sacken (1884) and others, who prefer a conventional terminology to a morphological one; and in such cases, the lateral region of the mesothoracic postscutellum, *ptg* of Fig. 6, B and D, is usually called the "metapleura".

The Metasternum. The metasternum is composed of a basisternum and furcasternum in most Diptera, in which the furcasternum

bears the paired internal apophyses, or furca, for muscle attachment (see Fig. 8, Plate 3 of paper by Crampton, 1925b). The metasterum, *bs* of Fig. 6, A, B and C, is quite distinct in most Diptera, but the meropleural sclerite, *mpl* of Fig. 6, C, is usually interpreted as the "metasternum" in the higher Diptera, and the mesothoracic meron, *me* of Fig. 6, A and D, is usually interpreted as the "metasternum" in the lower Diptera, although these sclerites are sometimes regarded as the posterior region of the mesosternum or even as the episternum of the metathorax (Young, 1921, in the culicids, etc.). Young (1921) considers that the sclerite labelled *bs* in Fig. 6, B, C, E, etc., represents the pleurotrochantin, instead of the sternum of the metathorax, but the ventral portion of this sclerite, at least, belongs to the basisternal region of the metasternum.

6. Basal structures of the wings

The venation of the wings has been figured in a separate chapter by Dr. Friend, so that only the basal structures of the wings will be discussed here. These include the axillary sclerites, calypteres, axillary lobe, and other structures not actually parts of the veins themselves.

The Axillary Sclerites. The axillary sclerites, alar ossicles or pteralia, are the small plates situated between the lateral margins of the notum and the bases of the wing-veins. They are apparently formed, in part, as detached portions of the lateral region of the notum, and partly as detached basal portions of the wing-veins, or as sclerotized areas at the bases of the veins. These articulatory sclerites enable the wing to be laid back and stretched out more readily, and some of them are involved in the movements of flight. The sclerites of one of the Tabanidae (Fig. 7, 1), which occupy a position intermediate between the lower and the more specialized Diptera, will serve to illustrate the structures in the basal region of the wing of a typical dipteran.

The tegula or "epaulet", *tg* of Fig. 7, I, and Fig. 6, A, C, and E, is a small anterior sclerite situated in an incision of the lateral region of the notum just in front of the anterior wing process of the notum. This sclerite is homologous with the sclerite called the tegula in the Hymenoptera and other insects, and Sharp (1897) very justly objected to the application of the term tegula to other structures (calypteres) in the Diptera.

The sclerite, *bac* of Fig. 7, I, was originally called the parategula in the Diptera, but Shannon (1924) has suggested that it be called the basicosta, and this designation is a very appropriate one for this sclerite, since the sclerite in question apparently represents a detached basal portion of the costal vein of the wing. Snodgrass (1935) more recently refers to this sclerite as the humeral plate.

The sclerite, *no* of Fig. 7, I, is called the first axillary or the notopterale (notale), and probably represents a detached portion of the lateral edge of the notum. It articulates with the lateral edge of the notum, and its anterior neck-like region abuts against the base of the subcostal vein.

The sclerite, *mm* of Fig. 7, I, situated next to the notopterale, *no*, is called the second axillary or the intraalare. It lies along the sclerite, *no*, and is contiguous anteriorly with the base of the radial vein. A ventral portion of this sclerite dips below the surface of the wing and rests upon the alifer or pleural fulcrum of the wing. This ventral portion forms the intraalare proper, while the dorsal portion is sometimes called one of the medial wing plates, although Snodgrass (1927) calls the entire plate the intraalare.

The third axillary or basanale, *ba* of Fig. 7, I, is situated near the base of the anal veins, and is connected with the posterior wing process, *anp*, by the fourth axillary or adanale, *aa*. The adanal sclerite, *aa*, is probably a detached portion of the posterior wing process, *anp*.

There are other plates in the basal region of the wing, such as the mediale, *mm* (the distal one of the medialia), and the intervenal area, *iv*, etc., but these sclerites are of less importance than the other axillaries in the movements of flight.

It is rather interesting to note that a basal fold occurs in the wing of the tabanid shown in Fig. 7, I, corresponding to a similar fold in the wing of other insects which are capable of laying the wings back along the abdomen in repose (Bulletin Brooklyn Ent. Society, 23, 1928, p. 113).

The Calypteres and Axillary Lobe. Three postero-basal lobes, labelled *bcl*, *dcl* and *alo* in Fig. 7, I, are visible in the extended wing of a tabanid or muscoid fly. The distalmost lobe, *alo*, marked off by the axillary incision, *inc*, is called the axillary lobe, alula, lobulus, or posterior lobe of the wing, while the two basal lobes, *dcl* and *bcl* are called the calypteres (and the terms squamae, tegulae, alulae, etc., are also applied to them by different writers). When they are spoken of separately, the lobes *bcl* and *dcl* may be called the proximal or lower calypter, *bcl*, (which is attached to the thorax) and the distal or upper calypter, *dcl*, (which is attached to the wing). When they are referred to in this connection, Haliday (1836) calls them the interior and exterior auricles, Walker (1854) calls them the subscutellar and subaxillary winglets, Robineau-Desvoidy (1863) calls them the squama inferior and superior, Comstock (1924) calls them the squamula thoracalis and squamula alaris, Lowne (1890-1895) calls them the squama and squamula, and Osten-Sacken calls them the tegula and antitegula, or squama and antisquama.

The calypteres are apparently modified portions of the axillary membrane, or membranous region at the base of the wing, and are usually bordered by the axillary cord, or thickened posterior margin of the axillary membrane, which is continuous with the posterior border of the anterior wing-bearing plate (eunotum) of the notal region. The fringe of hairs along the posterior margins of the calypteres is called the squamal fringe when the calypteres are referred to as the squamae.

The designations applied to the calypteres by some dipterists are applied to the axillary lobe, instead, by other dipterists (as is also the case with the term alula), and terms which are used for wholly differ-

ent structures in other insects are applied to the calypteres of the Diptera by some writers (as is the case with the term tegulae, etc.), with the result that a most disconcerting confusion has arisen, and it is highly desirable that an attempt be made to establish a uniform terminology for the structures in question, which will be acceptable alike to the taxonomists and the morphologists. In order to select the most appropriate designations for these structures, it may be of some value to review the terms which have been applied to them.

On page 584 of the well-known tenth edition of the "Systema Naturae," Linnaeus (1756) lists the distinguishing characters of the Diptera as follows: "Alae duae. Halteres clavati, solitarii, pone singulam alam, sub squamula propria." Linnaeus thus designates the (lower) calypter which covers the halter, as a squamula; and Curtis and a number of other dipterists likewise apply the designation squamula to the calypteres. Lowne (1890), however, restricts the designation squamula to the upper calypter, *dcl* of Fig. 7, I, and designates the lower one, *bcl*, as the squama. Osten-Sacken (1896, p. 286) states that "squama or squamula was the term almost universally used (for the calypteres) . . . . . Fabricius, Fallen, Meigen, Zetterstedt, Erichson (die Henopier), Schiner, all have squama. Illiger, Terminologie (1800, No. 1818) has squama halterum." On page 288, Osten-Sacken (1896) suggests that the calypteres be called squamae when taken together, but that when they are considered separately, the lower one should be called the squama, while the upper one should be called the anti-squama.

Audouin, who is responsible for most of the terms now used for the parts of the thorax in insects, applied the term squamula to the true tegula in Hymenoptera (see footnote to page 41, Vol. 25, of the Ann. Sci. Nat., Ser. I, 1832), as also does MacLeay, who attributes this usage to Latreille. The term squama, however, is used for the lens-shaped basal segment of the abdomen in ants, as well as for the sclerite which bears the palpus in the maxilla and labium of Odonata, and for one of the sclerites of the genitalia, etc., so that the terms squamula and squama cannot be restricted to the calypteres of the Diptera without creating confusion; and furthermore, the term squama is too much of a general descriptive designation for any scale-like structure of the body, to be restricted to a single structure, as must be done in employing an exact morphological terminology for definite parts of the body.

Kirby and Spence (1826, Vol. 3, p. 625) called the calypteres "alulae or winglets", and this usage was adopted by Westwood, Walker, Haliday, and other British dipterists, but many other dipterists have followed Loew (1862, page xxi, and Fig. 1, page xxiv, of the chapter on "terminology") in restricting the term alula to the axillary lobe of the wing, *alo* of Fig. 7, I; and this usage has become quite general among modern dipterists.

Loew (1862, page xiv of the "terminology") applies the term tegulae to the calypteres, and Osten-Sacken at first adopted this usage, applying the term tegula to the proximal or lower calypter, and calling the distal or upper calypter the antitegula. Later, however,

Osten-Sacken (1896) and Meade (1897) object to the application of the term tegulae to the calypteres on the grounds that the term tegula implies concealment, whereas the distal calypter does not conceal the halter, and even the proximal (or lower) one does not conceal the halter in such Diptera as the Tabanidae, etc. The real objection to Loew's application of the term tegulae to the calypteres of the Diptera is that the term tegula has always been applied to a totally different structure in other insects, namely the shell-like structure in the antero-basal region of the fore wing of the Hymenoptera, Lepidoptera, etc., ever since it was first introduced by Kirby and Spence (1826, Vol. 3, p. 377); and this term should therefore be applied only to the corresponding structure in the Diptera—namely to the structure labelled *tg* in Fig. 7, I.

The suggestion of Sharp (1897), who has proposed that the lower calypter be called a "calyptron" (incidentally, the Greek word calyptra, meaning a veil, hood, or head-covering, is itself a singular noun, and is therefore not a pleural form of "calyptron") "when it acts as a covering for the halter," while it should be called a squama when it does not act as a covering for the halter, is quite inadmissible from the standpoint of comparative morphology. A morphological term is a designation, not a description (although it may well be both), and it would lead to a needless multiplicity of terms if homologous structures were called by different names every time they happen to vary in size, or with respect to the angle at which they are borne on the body, and other non-essential features, so that Sharp's suggestion has little to recommend it.

The designation calypteres is the pleural form of the Greek noun calypter, meaning a sheath, which is listed in Smith's "Glossary of Entomology," but this was apparently not known to Osten-Sacken (1896), who refers to the terms calyptra of Haliday (1836), calyptera of Rondani, and calypta of Robineau-Desvoidy (1873, Hist. des Dipt. d. Env. de Paris, I, p. 77) and quotes Desvoidy's derivation of the term calypta in a passage which may be roughly translated as follows: "I retain for this double structure (i. e., the calypteres) the French name cuillerons (cuilleron signifies the bowl of a spoon), but I translate it into Latin by the word calypta, from calypto, I cover, while I designate the two scales which compose it, by the terms squama superior and squama inferior." Desvoidy thus apparently calls the calypteres the "calypta" when they are taken together, but refers to them as squamae when they are considered separately. For the sake of uniformity, however, it is preferable to use only the designations calypter and calypteres for the lobes *bcl* and *dcl* of Fig. 7, I, and this usage has everything to recommend it, with none of the disadvantages involved in the usage of many of the other terms applied to these structures. The term calypter (or calypteres) is one of recognized standing (see Smith, 1906), and has long been used by Coquillett and other dipterists. It is extremely appropriate for referring to the distinguishing characters of the calypterate Cyclorrhapha; and since it has never been applied to any structures other than the calypteres of the Diptera, there is no possibility of confusion when it is used for these structures.

It is likewise advisable to use only the designation axillary lobe for the posterior lobe of the wing (*alo* of Fig. 7, I), as was suggested by Haliday (1839, Annals Nat. Hist., Vol. 3, p. 219) and Walker, who, according to Osten-Sacken (1896, p. 288), probably follow Stenhammar in this matter. This usage is in harmony with that of entomologists in general, who apply the designation axillary lobe to a homologous structure in the wings of Hymenoptera and other insects. On the other hand, the application of the term "alula" to the axillary lobe is at variance with general entomological usage, because the term alula is applied to a lobe homologous with the calypteres, not the axillary lobe, in insects other than the Diptera (e. g., the alula of hydrophilid beetles, etc.). It is likewise most confusing to have some dipterists follow Westwood, Walker, Haliday, and others, in referring to the calypteres as the alulae, while other dipterists follow Loew in referring to the axillary lobe as the alula; and the simplest and most logical way out of the difficulty is to employ only the terms calypteres and axillary lobe for the structures so designated here.

7. The halteres

Although Latreille and Kirby and Spence (see also the more recent discussion by Feuerborn, 1921) considered that the halteres represent abdominal structures, there is no longer any doubt that they are the greatly modified and reduced metathoracic wings. In the larval stages they are formed from wing-buds in the dorsal region of the metathorax, which are homologous with the mesothoracic wing-buds giving rise to the wings of the adult Diptera. In the pupal stages of primitive Diptera the halteres are enclosed in metathoracic wing cases, which are borne along the sides of the metanotum exactly as the wing cases of the mesonotum are borne. In the adults of such primitive Diptera as the tipulid *Holorusia grandis* (see Snodgrass, 1909, Fig. 210, Plate 69), the venation, axillary cord, basal articulation, axillary sclerites, tegula, etc., of a true wing are exhibited in the basal region of the halter; and in mutations of *Drosophila* described by Morgan (see Imms, 1929, Fig. 566, p. 602), the halteres have the form of small wings with a clearly recognizable venation, thus clearly proving that the halteres are the modified metathoracic wings.

A typical halter consists of a broader basal portion called the scabellum, a slender stalk called the pedicel or petiole (for which the term "midhalter" would be preferable, since the term pedicel refers to the second segment of the antenna, while the term petiole is usually applied to the constricted basal portion of the abdomen of certain Diptera and Hymenoptera), and a knob-like distal portion called the capitellum. The halter is quite mobile, being operated by four muscles attached to its basal region, and it is capable of rapid vibration. It contains blood and a fine branch of the tracheal system, and is innervated by one of the largest of the thoracic nerves.

The halter is an extremely sensitive organ, and its extirpation evidently administers a very severe shock to the insect. The experiments of Weinland (1891) and others indicate that the halteres are "balancing" organs and serve to coordinate the movements of flight;

but Leydig, Graber and others suggest that they may have an auditory function and other functions have been ascribed to them by recent investigators.* Internal, so-called chordotonal organs, and external sensory protuberances with transversely sculptured surfaces, occur in the basal region of halter (scabellum); and the halteres of most Nematocera are covered with so-called sense hairs, although these are largely restricted to the capitellum in the higher Diptera.

The halteres are absent in some degenerate parasitic forms and they are occasionally atrophied in some tipulids, mycetophilids, stethopathids, etc., but they are usually retained even when the wings are lost, and apparently play an important role in the general make-up of the insect.

c. The legs

The front, middle and hind legs (or the legs of the pro-, meso- and metathorax) are referred to as the pedes antici, medii and postici by Verrall (1901), who insists that the designation anterior legs (pedes anteriores) should include both the fore and middle legs, rather than the fore legs alone, and that the designation posterior legs (pedes posteriores) should include both the middle and the hind legs, instead of the hind legs alone. Thus, according to Verrall, there is only one pair of front, middle or hind legs, while there are two pairs of anterior or posterior legs according to his terminology; and he applies the same usage to the parts of the legs, such as the femora, tibiae and tarsi, as well. Verrall's suggestion, however, has not been accepted by most dipterists.

Various methods of designating the different surfaces of the legs have been proposed by Schnabl (1906), Stein (1903), and other dipterists, but the method which has been followed by most dipterists is that suggested by Grimshaw (1905). If the legs be thought of as though they extended parallel to each other and perpendicular to the median plane of the body, with the tibia and tarsus as nearly as possible in a straight line with the femur, it will be readily seen that each leg has an anterior, posterior, dorsal and ventral surface. The surface between any two of these four principal surfaces is designated by a combination of the names of the two surfaces concerned. Thus the antero-dorsal surface is the one between the dorsal and anterior surfaces; the antero-ventral surface is the one between the anterior and ventral surfaces; the postero-ventral surface is the one between the ventral and posterior surfaces; and the postero-dorsal surface is the one between the posterior and dorsal surfaces. A combination of these gives eight surfaces for the leg. Looking down on the right side of the insect's body, with its head to the right, and with its legs extended at right angles to its body, the following sequence is passed through in working around the leg, starting at the top, and following a clockwise sequence, namely: the dorsal, antero-dorsal, anterior, antero-ventral, ventral, postero-ventral, posterior, and postero-dorsal sur-

* According to Buddenbrock (1919), the halteres may be regarded as "stimulatory organs" (Wolsky, 1933), and the stimuli of their rapid vibrations may serve to maintain the tone or vigor of the active muscles of flight.

faces. The surfaces of the femur and tibia which are apposed when the leg is folded together (like a knife) are called the ventral surfaces of these segments according to Grimshaw's terminology; but these surfaces are frequently called the flexor surfaces by other dipterists, who refer to the opposite surfaces as the extensor surfaces.

Snodgrass (1927, p. 93) follows Boerner, Heymons, and other German entomologists in considering that the pleural sclerites of an insect represent the modified basal portions of the leg (called the subcoxa) of a crustaceoid arthropod, and compares the coxa with the coxopodite, the two parts of the trochanter with the basipodite and ischiopodite, the femur with the meropodite, the tibia with the carpopodite, and the pretarsus with the dactylopodite, in interpreting the parts of an insect's leg in terms of the parts of a typical crustacean limb. Although such a comparison of the parts of the legs in the representatives of two distinct classes of arthropods is necessarily somewhat speculative, it seems to be fairly well established that the pretarsus (acropod), or region beyond the fifth tarsal segment, of an insect's leg represents a distinct segment, the dactylopodite of a crustacean's leg, as was first pointed out by de Meijere, 1901, although this small region is usually overlooked by entomologists in describing the segmentation of the leg of an insect.

The coxa, *cx*, articulates dorsally with the coxifer, *cf*, (Fig. 6, F) or pleural process at the ventral end of the pleural suture. A sternal articulation of the coxae of the meso- and metathorax is frequently formed by two wing-like extensions (one on each side) of the furcasternum, which is folded between the middle coxae when they become approximated mesally.

The prothoracic coxae are frequently more cylindrical than the others, and in such empids as the one shown in Fig. 8, G, the prothoracic coxae are extremely elongated and slender. The coxae of most Mycetophilidae are quite elongated, although in most Diptera the coxae are not as a rule greatly elongated even when the femur and tibia become extremely elongated as is the case in the Tipulidae. In such parasitic forms as the Hippoboscidae (Fig. 6, E and F), the coxae are rather short and stout, and are quite mobile.

The mesothoracic* coxae are divided into an anterior region or eucoxa, *ec*, and a posterior region or meron, *me*, in the tipulid shown in Fig. 6, A; and the meron, *me*, becomes increasingly closely associated with the lower region of the epimeron, *em*, (Fig. 6, D), until in the higher Diptera it unites completely with the lower portion of the epimeron to form the composite region labelled *mpl* in Fig. 6, C. In such cases the eucoxa may become divided into a basal region, *bcx*, (which remains rather closely united with the region *mpl*) and a distal region, *dcx*, which becomes detached from the rest of the eucoxa, in order to restore the mobility of the basal region of the leg, which is lost when the meron, etc., become united with the lower portion of the epimeron. In such mycetophilids as the one shown in Fig. 6, B, the meral region, *me*, unites with the lower portion of the epi-

*The mesothoracic coxae of the mycetophilid *Mycomyia maxima* bear long, slender, forward-projecting processes or "coxal spurs" which are developed only in the males.

meron, *cm*, but the meral region of the coxa becomes membranous so that the mobility of the leg is not impaired. The meral region of the mesothoracic coxa is frequently mistaken for the posterior portion of the mesosternum, or for the metasternum, or even for the metathoracic episternum, etc. The metathoracic coxa is not divided into a eucoxa and meron in the Diptera, nor is the prothoracic coxa so divided in any insects, although a narrow marginal region (basicoxa) in the basal region of the prothoracic coxa includes a posterior area, which is homologous with the meron of the mesothoracic coxa. This area is small and unimportant in the prothoracic coxa; but it becomes greatly enlarged and occupies the greater portion of the posterior region of the coxa in the mesothoracic leg.

The trochanter, *tr*, has a movable articulation with the coxa, but is immovably united with the femur in most insects, and usually appears to be merely a demarked basal region of the femur, although Snodgrass (1927) and others consider that the trochanteral region of certain insects represents the union of two segments of the leg of such arthropods as the Crustacea, etc. The trochanter is usually small and relatively unimportant in the Diptera.

The femur, *fe*, and the tibia, *ti*, are usually the longest segments of the leg, and are extremely elongated in the Tipulidae. In some Empidae (Fig. 8, G) and Ephydridae (Fig. 8, M) the prothoracic femur, *fe*, is rather stout and bears strong bristles; and the tibia fits against the femur in a fashion very suggestive of the fore legs of the mantids and other predaceous insects. In the male *Sepedon* shown in Fig. 8, A, the metathoracic femur and tibia are bent in a peculiar fashion, and the femur is provided with stout processes which may be used in mating. The mesothoracic femur is similarly provided with stout spine-like processes in the stratiomyid shown in Fig. 7, C. In the male syrphid shown in Fig. 8, F, the prothoracic femur bears long hairs bordering a groove the purpose of which is not known. In the empid shown in Fig. 8, D, the femur and tibia of the posterior legs are bordered by broad, flattened, scale-like setae which give a feathery appearance to the legs; and structures somewhat similar to these are borne on the hind tibiae of the tachinid *Trichopoda pennipes*, although there is no close relationship between these two insects.

One or more distinct short spurs, called tibial spurs, are borne at the distal end of the tibiae, and the number of these tibial spurs is a feature used in classification. According to Comstock (1924, p. 778), "The number of tibial spurs borne by the different pairs of legs is often indicated by a brief formula, as, for example: 'tibial spurs 1:2:2' indicates that the fore tibiae bear each one spur; the middle tibiae, two; and the hind tibiae two."

The tarsi, *ta*, are typically pentamerous in the Diptera; and the five segments which compose the tarsus may be called the tarsomeres. The basal tarsomere, *bt*, (Fig. 8) is the basitarsus, and the distal tarsomere, *dt*, is the distitarsus. The basitarsus is usually called the "metatarsus", but the designation meta-tarsus signifies the entire tarsus of the metathoracic leg, and should not be applied to any other structures.

The tarsomeres are usually quite slender (Fig. 8, A and G), but in some Diptera, such as the syrphid shown in Fig. 8, F, they may become fairly broad, and in the syrphid shown in Fig. 8, J, the broad tarsomeres bear long bristles. The basitarsus, *bt*, of the fore leg of the empid shown in Fig. 8, H, is greatly enlarged and swollen. The distitarsus, *dt*, of the fore leg of the male dolichopodid shown in Fig. 8, I, is enlarged and compressed, and is clothed with short black hairs; and in the males of the asilid *Cyrtopogon callidipes*, the two distal tarsomeres of the middle leg bear a dense tuft of black bristles on each side, forming a disk of setae, as a secondary sexual character of the male. In the males of the platypezid *Platypeza pallipes* Lw. (*Calotarsa ornatipes* Townsend), and in the males of *Calotarsa calceata* Townsend, shown in Fig 8, B and C, the first four tarsomeres of the hind leg are strikingly modified and bear peculiar outgrowths occurring only in the male sex, so that the tarsus appears to be the region of the leg which presents the most striking secondary sexual characters. Minnich (1926-1929) and others have investigated the sensitivity of the tarsi of flies to various chemical stimuli, but the subject is still under discussion.

Just beyond, or distal to, the last segment of the tarsus *dt* of Fig. 8, K and L, is a small terminal segment of the leg which may be called the posttarsus or acropod. This small region represents a distinct and separate portion of the leg, although it is usually overlooked in enumerating the segments of the leg, because of its relative insignificance. This region is called the "praetarsus" by de Meijere, 1901, (although it is posttarsal in position), who homologizes it with the terminal segment, or dactylopodite, of a crustacean limb.

The unguitractor, *u* of Fig. 8, K and L, is the principal sclerite of the pretarsus or acropod. The unguitractor muscles, attached to the unguitractor tendon, *ut*, draw the unguitractor plate, *u*, back into the cavity of the distal segment of the tarsus *dt*, when they contract. This causes the unguitractor plate *u* to pull upon the flexor membrane attached to the sclerites *bu* (Fig. 8, L and K) and to the claws *un* (which are articulated to the dorsal, claw-bearing process or unguifer, at the distal end of the last tarsal segment), thereby flexing the claws, which become extended again through the natural resiliency of the parts, when the unguitractor muscles relax. The claws, or ungues, *un*, are usually simple, but may be toothed or dentate in some parasitic forms, etc., as is the case in the hippoboscid shown in Fig. 8, E.

Immediately beyond, or distal to, the unguitractor plate *u* is the ventral plantar area, which in a few Diptera (such as the Trichoceridae, Simuliidae, etc.) contains a narrow transverse sclerite called the planta. Two small sclerites (one on each side of the plantar area) called the basipulvilli (*bu* of Fig. 8, L and K) are located at the bases of the pulvilli, *pv*, or claws, *un*, and are of fairly wide-spread occurrence in the Diptera.

In certain Tipulidae, Trichoceridae, etc., a single median lobe or sac of the acropod (pretarsus) is developed, and is apparently homologous with the median unpaired structure called the arolium in orthopteroid insects such as the Blattidae, etc. The writer (Crampton,

1923) formerly considered that the lobe-like pulvilliform empodium, *ar*, of the Tabanidae (Fig. 8, L) etc., represents an arolium, because it extends dorsally to the unguifer, or claw-bearing process of the distitarsus, while the setiform empodium (*em* of Fig. 8, K) of the Asilidae, etc., is a true empodium, because it appears to be a process of the unguitractor plate, *u*, and does not extend dorsally to the unguifer. Holway, 1937, (M. S. C. doctor's thesis on the "Pretarsus of Insects"), however, agrees with Ockler (1890) and the dipterists in general, who consider that the setiform empodium (*em* of Fig. 8, K) and the pulvilliform empodium (*ar* of Fig. 8, L) are homologous structures, and supports the view of de Meijere (1901), who considers that the entire arolium of the Tipulidae and Trichoceridae is not strictly homologous with the pulvilliform empodium of the Tabanidae (*ar* of Fig. 8, L).

According to Holway, 1937, (l. c.) the arolium, such as that occurring in the Tipulidae, Trichoceridae, etc., is a median sac-like outpouching of the acropod (pretarsus) which includes a dorsal region, typically membranous (although it may contain sclerotized areas), and a ventral plantar area, from which an empodium of the pulvilliform or setiform type may develop; and the setiform empodium appears to be a process of the unguitractor plate when the membrane between the plantar area and the unguitractor becomes sclerotized to form a continuous surface extending from the unguitractor plate into the empodium.

In the acropod (pretarsus) of the Simuliidae, a dorsal unpaired median lobe is folded over the ventral setiform empodium, and Holway interprets the dorsal lobe as the dorsal region of the arolium, in which the ventral plantar area has developed into a setiform empodium, although in most Diptera the dorsal arolear membrane becomes reduced, when the ventral plantar area develops into an empodium of the setiform or pulvilliform type.

A pulvilliform empodium is developed in certain Ptychopteridae, Anisopodidae, Mycetophilidae, etc., among the Nematocera, in which the pulvilli or lateral pads at the bases of the claws (*pv* of Fig. 8, L) are usually not developed. In some species of *Sciara*, however, a small pulvillus occurs on each side of the pulvilliform empodium; and in such bibionids as *Bibio*, *Aspistes*, etc., well developed pulvilli flank the pulvilliform empodium, as is also the case in the brachycerous families Leptidae, Stratiomyidae, Tabanidae (Fig. 8, L), etc.

An empodium of the setiform type may occur in such Nematocera as the Chironomidae and Culicidae, but it is not flanked by pulvilli in the Culicidae. A setiform empodium usually flanked by pulvilli (although the pulvilli may become slender and elongated in such forms as the Asilidae, Mydaidae, etc.) occurs in the brachycerous families Therevidae, Mydaidae, Asilidae, Bombyliidae, Cyrtidae, Empidae, Dolichopodidae, etc., and such a setiform empodium flanked by pulvilli is typical of most Cyclorrhapha. The setiform empodium of the hippoboscid shown in Fig. 8, E, is rather broad, and in such Diptera as certain Asilidae, Cyrtidae, Dolichopodidae and Empidae, the setiform empodium may become markedly widened basally; and such types of empodium, according to Holway, 1937, (l. c.) represent in-

termediate stages between the pulvilliform and true setiform types of empodium.

The pulvilli (and pulvilliform empodium) of many flies bear hollow tenent hairs, or retineriae, through which a sticky exudate is poured out to enable the flies to cling to smooth, vertical surfaces, or to walk about "upside-down". The pads are readily released by rolling them inward from the margins.

Legs of an extremely long and slender type are to be found among the Tipulidae, while those of a stouter type occur more frequently in the higher Diptera such as the Phoridae, Hippoboscidae, etc. The bases of the legs are approximated extremely closely in the mycetophilids, while they are widely separated in the hippoboscids, nycteribiids, and similar forms, in which the legs usually project laterally very markedly. The legs are completely lost in the females of the peculiar streblid *Ascodipteron* and allied forms which bore into the skin of their hosts and assume an appendageless, sac-like condition, bearing no resemblance to a typical adult insect.

Morphology of the Abdomen and Its Appendages

Young (1921) has discussed the basal abdominal segments of most of the dipterous families, but does not include a discussion of the terminal abdominal structures in his fine paper on the abdomen of the Diptera. Hendel (1928) describes some of the abdominal structures, in his general discussion of the external morphology of the Diptera, and Snodgrass (1935) and Berlese (1909) discuss the structure of the abdomen of the Diptera in their descriptions of the abdominal structures of insects in general. The abdominal sternites of the Tachinidae are described by Baronoff (1930) and parts of the abdomen of various Diptera are figured in such publications as those of Seguy (1935) and other general works on the Diptera; but no extensive discussion of the entire abdominal region of the Diptera has as yet been published, and much remains to be done in this promising field of research. Figures of the abdominal structures of individual Diptera will be found in the publications of Hewitt (1914) on *Musca*, Parker (1914) on *Sarcophaga*, Worthley (1924) on *Trichopoda*, Seamans (1920) on *Anthomyia*, Kuenckel d'Herculais (1875-1881) on *Volucella*, Bromley (1926) on *Tabanus*, Tokunaga (1930 and 1932) on *Limonia* and *Pontomyia*, Williams (1933) on *Protoplasa*, and Rees and Ferris (1939) on *Tipula*.

The terminal abdominal structures of the females of several types of nematocerous Diptera are discussed by Gerry (1932), and the parts of the abdomen of the female of one or two types of Diptera are figured by Boerner (1903), Berlese (1909), and Hendel (1928). Discussions of the parts of the female in individual Diptera are to be found in the papers of Mote (1929) on *Hypoderma*, Dampf (1933) on *Anastrepha*, Dean (1935) on *Rhagoletis*, Huckett (1921) on the Anthomyidae, Dinulescu (1930) on *Stomoxys*, Patton (1934) on *Glossina*, Christophers (1923), Davis (1926), and Macfie and Ingram (1922) on female mosquitoes, Metcalfe (1933) on *Dasyneura*, Sinton

(1925) and Christophers and Barraud (1926) on *Phlebotomus*, and Snodgrass (1903) on the Tipulidae.

The best paper on the genitalia of male Diptera is that of Cole (1927), who has described the genitalia of most of the dipterous families, while Muir (1923), Smirnov (1925), and Wesché (1906) have discussed the parts of the males in a number of dipterous types, and Snodgrass (1935), Crampton (1923-1941), and Newell (1918) have compared the genitalia of male Diptera with those of other insects. Discussions of the male genitalia in smaller groups of Diptera will be found in the papers of Brolemann (1923), Liang (1926), Meijere (1921), Snodgrass (1904 and 1935), Tokunaga (1930), and Westhof (1882), together with various papers by Alexander, Edwards, and others on the Tipulidae; Christophers, Shortt and Barraud (1926), Feuerborn (1922a), Friele (1930), and Perfilieo (1928) on *Phlebotomus*; Oka (1926) and Tokunaga (1932a) on the Chironomidae; Christophers (1915, 1922, and 1923), Dyar (1918), Edwards (1920b), Freeborn (1924b), Martini (1922), Root (1924), Essig (1942), and Frost (1932) on male mosquitoes; Gibbins (1935) on male Simuliidae; Bromley (1926) on *Tabanus*; Snodgrass (1902 and 1904b) on Asilidae and Dolichopodidae; Metcalf (1921) on male Syrphidae; Hennig (1934) on the Micropezidae; Sulc (1928) on the Sepsidae; Huckett (1924) on the Anthomyidae; Dinulescu (1930) on *Stomoxys*; Hewitt (1914) on *Musca*; Pinto (1931) and Patton (1932-1935) on various Muscidae; Bruel (1897), Rohdendorf (1926), and Schraeder (1927) on *Calliphora*; Baronoff (1927), Mueller (1922-1926), Petzold (1927), and Rohdendorf (1927) on the Tachinidae; Boettcher (1912-1913), Aldrich (1916), and Parker (1914) on the Sarcophagidae; and Mote (1924), and Carpenter and Hewitt (1914) on *Hypoderma*. Figures of the genitalia of the males of various Diptera are to be found in many of the recent monographs and descriptions of new species, but these are too numerous to be included here.

1. The principal landmarks of the abdomen

The most important landmarks for identifying the parts of the abdomen are the location of the genital openings of the female and male (with the twining ejaculatory duct of the male), the cerci and anal opening, and the spiracular openings (with their distorted tracheae).

The position of the female genital opening, which is located between the sterna of the eighth and ninth abdominal segments (or just behind the eighth sternite) serves to identify the eighth or genital segment of the female, while the location of the genital forceps, and particularly the aedeagus, which are structures of the ninth segment, serves to identify the ninth or genital segment of the male. Furthermore, the fact that the aedeagus, or male organ, is a sternal structure, enables us to identify the ninth sternite when it becomes inverted or displaced in the torsion process. The looping up of the vas deferens and ejaculatory duct (Fig. 9a, A) from left to right over the top of the hindgut (which occurs in all male Cyclorrhapha)

likewise enables us to be certain that a torsion has occurred in this direction, and indicates the path of displacement followed in the shifting of the seventh and eighth sternites which occurs in the males of the higher Diptera.

The fact that the spiracles are borne within, or just below, the lateral borders of the tergites enables us to determine which sclerites are tergites, and which are sternites, when there has been a marked displacement and distortion of the parts in male Cyclorrhapha; and the displacement of the spiracles, particularly the downward shift of the dextral spiracle of the seventh segment (or even that of the sixth segment) into the sternal region—or even on around into the lower region of the insect's left side (see Fig. 12, H), serves to indicate the extent of the torsion of the parts in these Diptera. The distortion and displacement of the accompanying tracheae is likewise of value for indicating the nature of the torsion process, and furnishes important evidence that a left-to-right torsion has taken place in the seventh and other abdominal segments, although the condition exhibited by the spiracles and their tracheae is of little value for determining the nature of the torsion of the parts behind the seventh segment, since the latter is the last spiracle-bearing segment in male Diptera.

The spiracular openings are features of prime importance for determining the nature of the tergites in the basal region of the abdomen, since the corresponding spiracles remain distinct when the first two tergites which originally bore them become more or less completely united to form a syntergite, or composite apparent first tergite in certain Diptera. The spiracles are not infallible indices of segmental fusion, however, since the spiracles of the seventh abdominal segment may shift forward into the sixth abdominal segment (which then bears two pairs of spiracular openings) in the postabdomen of certain female Cyclorrhapha, although the sixth abdominal segment is not composite in such cases. (See Fig. 9a, B, C and D.)*

The occasional persistence of the spiracles, when the segments which originally bore them become membranous and the segmental boundaries become obliterated, is a feature of some value for determining the segmental composition of the abdominal region in some of the highly specialized Diptera. Although the location of the spiracles does not furnish us with accurate information concerning the exact boundaries of the segments in such cases, it is at least evident that the segmental boundaries must lie between the areas occupied by the spiracles in these Diptera.

*In males of the anthomyid *Fannia canicularis,* the left spiracle of the sixth abdominal segment migrates back into the synsternite (composed of the lateroverted seventh and inverted eighth sternites) behind it, so that the synsternite bears two sinistral spiracles (those of the sixth and seventh segments), and a somewhat similar condition occurs in the male of the calliphorid *Calliphora erythrocephala.* In most male tachinids the sinistral sixth spiracle lies in the lateral membrane, but in some tachinids it migrates back into the synsternite (composed of the seventh and eighth sternites) behind it, which also bears its own sinistral spiracle (that of the seventh segment), and in such instances the presence of the left spiracle of the sixth abdominal segment in the synsternite does not indicate that the sixth abdominal segment enters into the composition of the synsternite.

The fact that the anal opening is always dorsal in relation to the ventrally located genital openings of lower insects is of some value for determining which structures are tergal and which are sternal when an inversion or similar displacement of the parts occurs in the Diptera. Furthermore, the cerci occurring on each side of the anal opening in the higher Diptera, represent the appendages of the eleventh abdominal segment of lower insects, so that it is extremely probable that the eleventh abdominal segment enters into the composition of the composite, cerci-bearing, so-called "anal segment" occurring behind the ninth or genital segment of the males of the higher Diptera.

2. Morphology of the abdomen

The segments of the abdomen are called uromeres or urites, and the dorsal plates of the uromeres are usually called tergites,* while the ventral plates are called sternites, and the lateral plates, when present, are called pleurites. The membranes between the tergites and sternites are the lateral or pleural membranes, while the membranes between the consecutive segments are the intersegmental membranes, or conjunctivae.

The extent of the pleural membrane varies greatly even among the members of the same group of Diptera. Thus, in the calobatid *Calobata* (Fig. 10, F), the tergites and sternites are widely separated by the extensive pleural membrane, while in certain other Cyclorrhapha, such as the tachinid *Thelaira*, the pleural membrane is reduced to the narrow inflexed areas between the greatly enlarged tergites and the greatly reduced sternites, which are overgrown by the enlarged tergites. In some phorids, and in such chloropids as *Chlorops*, etc., the entire sternal region may become membranous, while in some orphnephilids, hippoboscids, etc., the greater portion of the abdomen itself may become membranous, and in such cases the segmentation is largely indicated by the position of the spiracles.

The Spiracles. Originally, the first eight abdominal segments bore spiracles, and eight pairs of spiracles occur in some tipulids, bibionids, rhagionids (leptids), mydaids, etc., while seven or eight pairs are found in certain chironomids, orphnephilids, stratiomyids, scenopinids and asilids; the occurrence of seven pairs of spiracles is rather typical of the Diptera in general, and male Diptera apparently never have more than this number. Some chloropids and ephydrids have only six pairs of spiracles, and some anthomyids have only five pairs, although the reduced number is of comparatively rare occurrence.

The spiracles are typically borne near the middle of the segment, although the first pair usually occurs in the anterior region of the basal segment (or in the posterior region in such forms as *Oncodes*), while in some cases (*Allognosta*) all of the spiracles tend to shift

*Since recent morphologists apply the designations tergites, sternites, etc., to subdivisions of the terga, sterna, etc., it is suggested that the terga, sterna, etc., of the abdomen might be referred to as uroterga, urosterna, etc.

into the anterior region of their respective segments. In most of the Orthorrhapha and the athericeran and acalypterate Cyclorrhapha, the spiracles are found in the membrane between the tergites and sternites, while in most of the calypterate Cyclorrhapha they occur in the ventro-lateral region of the tergites which become enlarged in these Diptera, although there are exceptions to this general rule.

In many cases the occurrence of the spiracles is of considerable importance for determining the segmental composition of the sclerites around them, but a failure to realize that in some instances the spiracles may shift without reference to the adjacent sclerites has resulted in so much confusion in the attempts to identify the neighboring sclerites by the presence of the spiracles, that, at the risk of seeming to be unduly repetitious, attention should be called to this fact again, in discussing the occurrence of the spiracles in the abdominal region.

The occurrence of two pairs of spiracles in the basal abdominal tergite clearly indicates that the first two spiracle-bearing tergites have united to form the apparent first tergite, since a study of a series of intermediate stages (which is the most reliable means of interpreting the parts correctly) clearly proves that a union of the first two spiracle-bearing tergites has taken place. On the other hand, the occurrence of two pairs of spiracles in the sixth abdominal tergite of such female Diptera as the one shown in Fig. 9a, D, does not indicate that this tergite is formed by the union of two spiracle-bearing tergites (the sixth and seventh), as some investigators maintain, since a study of the transitional forms shown in Fig. 9a clearly indicates that the spiracles of the seventh abdominal segment have merely migrated forward to join those already present in the sixth abdominal tergite.

Since the spiracles are typically borne in or near the ventro-lateral region of their corresponding tergites, their occurrence should be of some value for determining which sclerites are tergites, and which are sternites, when the sclerites become distorted and displaced in the torsion process which occurs in the males of the higher Diptera; but here again, extreme caution must be used in attempting to identify the sclerites by their relation to the spiracles, since in some cases the spiracles appear to shift without reference to the sclerites with which they are normally associated. Thus, for example, in males of the anthomyid *Hylemyia antiqua* (shown in Fig. 13, D) the sinistral spiracle of the sixth segment lies in the membrane in front of the pregenital plate (labelled 7*s* and 8*s* in Fig. 13, D), while the sinistral spiracle of the seventh segment is borne in the anterior region of the pregenital plate. In males of the dexiid *Theleira nigripes*, on the other hand, both of these spiracles (belonging to the sixth and seventh segments) lie in the membrane in front of the pregenital plate, while in certain tachinids such as *Cylindromyia binotata* (or in the anthomyid *Fannia canicularis*) both of these spiracles are borne in the pregenital plate itself.

Although the spiracles of the sixth and seventh abdominal segments apparently shift about in such instances as these, the occurrence

of the seventh spiracles in the pregenital plate (e.g., that labelled *7s* and *8s* in Fig. 13, D) does indicate that the seventh segment participates in the formation of the composite pregenital plate, since a study of a series of transitional stages clearly indicates that the seventh segment enters into the composition of the pregenital plate; and it is also possible that the marginal area immediately dorsad of the seventh spiracles is formed by the reduced seventh tergite, although this is not certain. Furthermore, it should be noted that the presence of the seventh spiracles in the pregenital plate of male Cyclorrhapha such as those shown in Fig. 13, D, or Fig. 14, B (where the pregenital plate is labelled *7s* and *8s*) makes it impossible to interpret the entire pregenital plate as the eighth segment alone, as is done by some investigators, since there are no spiracles in the eighth abdominal segment of any male Diptera whatsoever, and the presence of the seventh spiracles in this case indicates that the seventh segment (as well as the eighth) enters into the composition of the pregenital plate of these Diptera.

The downward shifting of the dextral spiracles of the sixth and seventh abdominal segments into the ventral region of these segments, and on around into the insect's left side, in such male Diptera as those shown in Fig. 12, D and H, enables one to visualize the tremendous amount of distortion and displacement which has occurred in the neighboring sclerites in these insects, and in such instances as these, the positions assumed by the spiracles reveal the extent of the torsion process which has occurred in these insects. On the other hand, the final position of the spiracles may conceal rather than reveal the antecedent distortion and displacement of the parts, as is the case in the males of such higher Diptera as *Trichopoda pennipes*, in which the torsion process has apparently continued until a more or less complete circumversion has taken place, and a final re-alignment of the sclerites and spiracles results in a deceptively symmetrical arrangement of the parts outwardly, although a looping up of the ejaculatory duct over the top of the hindgut reveals the extent of the preceding torsion internally.

While instances such as these indicate the danger of depending too much on the evidence of the spiracles alone, in attempting to interpret the homologies of the sclerites about them, this does not detract from the value of the evidence of the spiracles when tested by that from other sources as well, and for this purpose the evidence furnished by a study of a series of intermediate forms is of the utmost value for interpreting the sclerites of the terminal abdominal segments of the higher Diptera in general, and of male Cyclorrhapha in particular.

The Segmentation of the Abdomen. A study of the embryology of the orthopteroid insects, which are the nearest living representatives of the ancestors of the Holometabola, indicates that the abdominal region is primitively composed of eleven true segments (of which the eleventh bears a pair of cerci), followed by a non-segmental, anus-

bearing, terminal region called the telson. The telson is usually reduced to a membranous region around the anal opening, and the eleventh abdominal segment tends to unite with the tenth even in the orthopteroid insects, so that it is not surprising to find a similar tendency exhibited by some of the lower Diptera, although some of them retain traces of an eleventh abdominal segment, as is the case in the female tipulid shown in Fig. 9, A.

The abdominal segments are best preserved in female Diptera: and in some of the primitive Nematocera, such as the tipulids, etc., the abdomen has its full quota of typical segments, with a pair of spiracles in each of the first eight abdominal segments. The ontogenetic development of these Diptera very conclusively shows that the thoracic region contains only three segments (i. e., the pro-, meso-, and metathorax) in these forms, and none of the basal segments of the abdomen enters into the composition of the thorax, as is erroneously claimed to be the case by Berlese (1909), Metcalf (1921), Balfour-Browne (1932), and others, who regard the apparent first abdominal segment in the Diptera as the true second or third segment of the abdomen.

Nine visible segments, followed by an inconspicuous anus-bearing segmental complex, called the "anal segment" or proctiger, are frequently present in the abdomen of male Diptera. The first seven of these segments may bear spiracles, although no spiracles have been found in the eighth abdominal segment of any male Diptera.

A reduction of the abdominal segments may take place in both sexes, (a) by the coalescence of the first two tergites in the basal region of the abdomen to form a syntergite, or composite apparent first tergite, and (b) by the fusion of the greatly reduced tenth and cercus-bearing eleventh segment (with which the anus-bearing telson had united) to form the proctiger; but the reduction of the segments in the other regions of the abdomen is not the same in the two sexes.

Huckett (1924) considers that the sixth and seventh abdominal segments have fused in the females of the higher Diptera in which the sixth segment bears two pairs of spiracles (as in Fig. 9a, D), and consequently maintains that the female gonopore (*fg* of Fig. 9a) lies behind the ninth, instead of behind the eighth sternite in these Diptera, unlike the rest of their allies. If one examines the series of female Diptera shown in Fig. 9a, B, C and D (in which the segments and parts correspond in every way), it is evident that the spiracles of the seventh segment, *7sp*, leave the seventh segment behind them when they migrate into the posterior region of the sixth segment, and the spiracles of the sixth segment, *6sp*, move slightly backward to join them in the sixth tergite, *6t* of Fig. 9a, D, which is therefore not the fusion product of two tergites, so that there is no fusion of segments in the postabdomen of these Diptera, although a fusion of another type may occur in the postabdomen of the female Diptera shown in Fig. 10, F, or Fig. 9, D, etc.

A type of segmental reduction wholly different from that occurring in the abdominal region of any female Diptera takes place in

the postabdomen of most male Cyclorrhapha, in which the tergites of the seventh and eighth segments become vestigial or atrophied, and their displaced sternites coalesce to form a synsternite (or synurite), with which the displaced sixth sternite may also unite, as in Fig. 13, C, or Fig. 14, D (compare also Fig. 12, I); and the sixth tergite may also become obliterated, as in Fig. 14, B, although no comparable reduction takes place in the segments of the abdomen of the females of these Diptera.

Modifications of the Basal Segments of the Abdomen. Young (1921) has figured the basal abdominal segments of many of the different types of Diptera, and some of these illustrate quite well the tendencies toward a fusion of the basal segments exhibited by certain of the higher Diptera. Starting with the condition exhibited by many tipulids, chironomids, etc., in which the first abdominal segment is distinct and well developed, a comparison with the basal abdominal region of such empids as *Rhamphomyia*, or such nemestrinids as *Hirmoneura*, shows that there is a marked tendency for the first segment to become reduced in comparison with the second segment; and in the scenopinid *Scenopinus*, the reduced first abdominal segment, which is distinct from the second dorsally, exhibits a marked tendency for its tergite to unite with the second tergite laterally. In the helomyzid *Leria*, the first tergite has united with the second tergite to form a syntergite, but the areas belonging to the two tergites are marked off by a transverse suture and by an incision on each side at the lateral ends of the transverse suture. In the chloropid *Chlorops*, the incomplete transverse suture fades out dorsally, but extends upward for a short distance above the incision on each side. In the ephydrid *Parydra*, only a deep incision remains between the uniting first and second tergites, while in the platypezid *Platypeza*, merely a slight notch on each side is left to show where the former division between the first and second tergites occurred, although the spiracles of the two segments still remain distinct. The series described above, and numerous others, serve to illustrate how the first abdominal tergite unites with the second in the Cyclorrhapha; and when the apparent first tergite bears two pairs of spiracles in these Diptera, it clearly indicates that the areas in which the spiracles are located were originally parts of two distinct segments. A corresponding fusion of the first and second sternites is extremely rare, although Young (1921) records its occurrence in the tabanid *Chrysops indus*.

Closely associated with the tendency for the first two tergites to coalesce is the tendency for the formation of a lateral suture (one on each side) extending from the latero-cephalic margin of the first tergite into the anterior region of the second tergite. The suture, labelled *adv* in Fig. 6, C, is called the adventitious suture by Young (1921), who states that it is less highly developed in the calypterate than in the acalypterate Cyclorrhapha. It has been observed only in the conopid *Myopa vesiculosa* outside of these two groups of higher

Cyclorrhapha, and is considered to be of some taxonomic importance by Young.

A feature of the basal abdominal segments which might give rise to some confusion in counting the segments in this region of the abdomen is the tendency for the first tergite to become subdivided into an anterior and posterior region by the formation of a secondary transverse suture in such Diptera as *Simulium*, or by a transverse strip of membrane, as in *Sciara* and in the stratiomyid *Allognosta.* The second tergite is similarly subdivided in the bibionid *Plecia*, in which the second sternite is likewise subdivided by a transverse membranous region; and similar secondary subdivisions of the second sternite occur in the tipulid *Pachyrhina*, in the empid *Rhamphomyia*, and in the calobatid *Calobata*, etc.

The Preabdomen and Postabdomen. The abdominal segments posterior to the fifth are not, as a rule, very greatly modified in the Nematocera, but the rest of the Diptera exhibit an increasingly marked tendency for the segments behind the fifth to become reduced and slender, with the result that the abdomen may eventually become divided into a preabdomen, which is usually composed of five abdominal segments, which are broader and more strongly sclerotized than the rest, and a postabdomen, which is frequently quite slender, and its segments may become telescoped into the preceding ones, or they may be concealed by the segments of the preabdomen.

The postabdomen of the females of the Diptera usually serves as an egg-laying tube; and in the higher Diptera, the postabdomen of the female usually plays an active part in the mating process, as is described in the mating of the housefly by Berlese (1902). The postabdomen of female Cyclorrhapha is not asymmetrically developed, as is the case in the segments of the postabdomen of the males of the higher Diptera, but the postabdomen may become highly modified in certain female Cyclorrhapha.

In male Cyclorrhapha the fifth abdominal segment frequently forms the last segment of the preabdomen, as it does in the females, but the coalescence of the first two tergites in the basal region of the abdomen may make it very difficult to count the segments properly, unless they are counted in the sternal region, where the sclerites usually remain distinct (although the first sternite may be small). The sternites of the preabdomen of such muscoid flies as *Stomoxys* may become reduced to small sclerotized plates or "islands" embedded in the broad ventral membrane; and the character of these plates is used as a feature of taxonomic importance by Girschner, and other students of these flies.

The fifth abdominal segment is not always the last segment of the preabdomen in male Cyclorrhapha, since Cole (1927) states that in some cases the preabdomen may be reduced to three segments; and in males of such Syrphidea as the one shown in Fig. 12, F, the fourth is the last segment of the preabdomen. In other types of Cyclorrhapha, such as the male calobatid shown in Fig. 14, C (com-

pare also Fig. 14, A), the sixth abdominal segment might be regarded as the last segment of the preabdomen, if the designation postabdomen is applied to the slender terminal abdominal region of these insects. The torsion and asymmetrical development of the segments of the postabdomen of male Cyclorrhapha has been discussed elsewhere.

The Terminalia. The designation terminalia was apparently first applied to the terminal abdominal segments located behind the genital segments. Freeborn (1924, p. 190), however, proposed that the designation terminalia be applied to "the complex of anal and genital parts borne caudad of the seventh abdominal segment." Recent investigators have further extended the application of the term to include practically all of the postabdomen of the higher Diptera when the segments of this region differ from the preceding ones, and this usage has been adopted here, since it has received increasingly wide acceptance among dipterists in general, and the students of the higher Diptera in particular.

Some recent investigators would use the term hypopygium as a synonym of terminalia (as here employed), and most culicidologists follow Christophers (1923, p. 701) in applying the designation "female hypopygium" to "the eighth (in part), the ninth and the tenth segments with their appendages, the intersegmental membranes and the openings of the anus and genital tract" in female mosquitoes. There is, however, no uniformity of opinion concerning the application of the term hypopygium among other dipterists. Thus, the students of the Tipulidae, such as Alexander and others, would include under the designation "male hypopygium" the eighth abdominal segment as well as the succeeding ones if (as is rarely the case) the eighth segment is especially modified—i. e., if it becomes swollen or enlarged, or if it bears lobes, hairy brushes, spines and other structures differentiating it from the preceding segments. Edwards (1920), on the other hand, includes only the ninth and the succeeding segments in the "male hypopygium", and, in a footnote to page 24, attributes this usage to Snodgrass (1904). Snodgrass (1904, p. 179), however, expressly states that he restricts "the application of the word hypopygium to the ninth segment only", and many dipterists have followed his suggestion that the term hypopygium be restricted to the ninth segment alone (i. e., without including the succeeding segments) in male Diptera.

The word hypopygium (apparently first introduced by Westhof, 1882) means "under-the-rump" and is therefore hardly applicable to the "rump" or anus-bearing parts behind the genital segment, and in fact Bergroth, 1888, (Entom. Tidskr., Vol. 9, p. 138 et seq.) has substituted the term propygium (meaning "in-front-of-the-rump") for the designation hypopygium in referring to the genital segments of male Diptera, since he states that the genital segments are in front of, rather than under, the rump (or proctiger), so that these dipterists, together with Snodgrass (1904) and other investigators, would exclude the anus-bearing parts behind the genital segments from the application of the term hypopygium, and this usage has much to

recommend it. We already have the designation terminalia for indicating the genital and postgenital segments, or the postabdomen (when its segments differ from the preceding ones), so that it is not necessary to employ the term hypopygium for the same parts, and it is therefore preferable to restrict the designation hypopygium to the genital segments, and their parts, in both sexes of the Diptera, since this usage is more nearly in accord with the meaning of the word hypopygium.

The designation "male and female genitalia" is frequently used as a synonym of "male and female hypopygium", but Edwards (1920), in a footnote to page 24, suggests that the designation male genitalia "should perhaps be confined to the chitinizations of the genital tube", and states that other designations such as male armature and copulatory apparatus, which have been applied to the hypopygium, are unsatisfactory.

Since there is no specific designation for referring to the parts in question, it is here suggested that the term genitalia be restricted to the parts in the immediate neighborhood of the genital opening of the male or female insect. The term genitalia would then denote the parts of the eighth and ninth sternites lying adjacent to the female genital opening (which is situated between the eighth and ninth sternites) and would also denote the parts adjacent to the male genital opening, namely the aedeagus and the parts on each side of it (such as the genital forceps of the males of the lower Diptera, and the so-called anterior and posterior gonapophyses of male Cyclorrhapha). We may then differentiate the male genitalia into the aedeagus, or male organ proper, and the ancillaries, or structures on each side of it, such as the genital forceps and the gonapophyses etc., mentioned above.

The highly modified cerci and surstyli of male Cyclorrhapha are so closely associated with the genitalia of these insects that all of these structures might be included in the designation "male armature". The designation copulatory apparatus, or copulatoria, might then be made to include all of these structures, together with the copulatory lobes of the fifth sternite of male Cyclorrhapha, since all of these structures serve as parts of the copulatory apparatus in the mating process. If this usage is followed, the designations genitalia, male armature and copulatory apparatus, will have more exact meanings than they do when used as synonyms of hypopygium, terminalia, etc.

The Genital Segments. The female gonopore, or the opening of the common oviduct, or the opening of the cavity into which it discharges, is located between the eighth and ninth abdominal sternites (or just behind the eighth sternite) but much of the cavity is contained in the eighth segment, which is therefore called the true genital segment (or gynium) of the female, although the ninth abdominal segment may also contain genital parts adjacent to the female gonopore. When the eighth abdominal segment of the female is called the gynium, its tergite is referred to as the epigynium and its

sternite is called the hypogynium. The valves of the eighth sternite are called hypovalvae or hypogynial valves in female Tipulidae.

The ninth abdominal segment which bears the male genitalia is called the genital segment, or andrium, in male insects. The ninth tergite is then referred to as the epandrium and the ninth sternite is called the hypandrium in these insects. When the ninth segment is called the andrium, the segmental complex preceding it may be referred to as the protandrium in the males of the Cyclorrhapha (Sarcophagidae, etc.), in which this structure is closely associated with the ninth segment. The students of these Diptera usually refer to the protandrium and andrium as the first and second genital segments; and these parts are also referred to as the pregenital and genital segments by some dipterists, but the so-called first genital "segment" or pregenital "segment" is not a segment at all, but is a synsternite, or composite sclerite made up of the united seventh and eighth sternites which have become displaced into the dorsal region. It is therefore preferable to refer to the synsternite and ninth segment as the protandrium and andrium. Furthermore, the designation pregenital segments is frequently applied to all of the abdominal segments anterior to the ninth or genital segment proper (or the segments called the visceral segments by Snodgrass, 1935), and this usage is an extremely useful one. In the lower Diptera the ninth or genital segment not only bears an aedeagus, or male organ proper, but also bears the two-segmented genital forceps, or forcipate parameres, homologous with the forcipate parameres of male Trichoptera, Mecoptera, Hymenoptera, etc.; and in the higher Diptera the ninth segment also bears the aedeagus and the paired so-called anterior and posterior gonapophyses (which may be peculiar to these Cyclorrhapha).

The Postgenital Segments. The designation postgenital segments refers to the segments behind the genital segments, and is usually applied to the segments behind the eighth abdominal segment of the female (when the ninth does not bear any processes, etc.) and those behind the ninth abdominal segment in the male. The postgenital segments are best developed in female Tipulidae, and are fairly well developed in the females of some of the higher Diptera (Fig. 9, F); but in most male Diptera they are reduced and fuse to form the small inconspicuous so-called "anal segment" or proctiger, borne behind the ninth abdominal segment.

The reduction and fusion of the postgenital segments to form a proctiger or composite "anal segment", *pgr*, is more extensive in the females of the higher Diptera shown in Fig. 9a, B, C and D, than in the corresponding males (i. e., *pgr* of Fig. 13, D, E and F, or Fig. 14, D, F and H, etc.), since the greater importance of the ninth segment as the functional genital segment of the male would prevent its reduction and incorporation into the proctiger in the higher Diptera, in which this consideration does not apply in the case of the female, since the eighth is the functional genital segment of the female, and

the ninth segment behind it could readily become reduced and unite with the other terminal segments to form a proctiger (in which the only important features are the sensory cerci, and the anal opening for the discharge of the faeces). In the lower Diptera, on the other hand, the proctiger of the male is usually smaller and more inconspicuous than that of the female, and this also holds true of the male rhagionid (leptid) shown in Fig. 12, A, in which the proctiger is more reduced than that of the female rhagionid shown in Fig. 9, F.

The stages in the development of the proctiger or "anal segment" may be illustrated by the series of female Diptera shown in Fig. 9, A, F and E. Thus in the female tipulid *Clytocosmus* shown in Fig. 9, A, the comparatively well developed ninth and tenth segments are distinct, and the cercus-bearing eleventh segment (with which the anus-bearing telson has united) is apparently represented largely by the distinct, though small sclerites at the bases of the cerci, *ce*. In the female rhagionid (leptid) *Chrysopilus* shown in Fig. 9, F, the cerci-bearing eleventh segment has united with the reduced tenth segment to form a composite apparent tenth "segment" bearing the cerci, *ce*, and still distinct from the ninth segment in front of it. In the female housefly shown in Fig. 9, E, the cercus-bearing composite "segment" (representing the united tenth and eleventh segments, with the telson) tends to merge with the ninth segment, and in the female Diptera shown in Fig. 9a, B, C and D, the segments behind the eighth have become indistinguishably united to form a cercus-bearing proctiger or "anal segment" (labelled *pgr* in the figures).

A suranal or supra-anal plate, called the epiproct, may occur in the dorsal region of the "anal segment" (above the anal opening), and a subanal plate, called the hypoproct, may occur in the ventral region of the "anal segment" (below the anal opening), but the exact homologies of these sclerites and the homology of the sclerite called the postgenital plate in the females of the lower Diptera studied by Gerry (1932) have not been definitely determined. It is possible that the paraprocts, or parapodial plates of lower insects, may enter into the composition of the plates below the anus in certain Diptera, but this can be determined only after these parts in the Diptera have been compared with those of the lower insects, and it is evident there is a decided need of more extensive and detailed studies of the terminal abdominal structures of both sexes, in the Diptera.

The cerci are usually better developed in the females than in the males of the lower Diptera, excepting in the dolichopodids, in which the cerci of the males may become enormously developed. The cerci may be two-segmented in the females of some Nematocera (mycetophilids) and Brachycera (stratiomyids), but they are usually composed of but one segment in the males of these insects; and in most of the Cyclorrhapha (excepting a few syrphids) the cerci are composed of but one segment in both sexes, those of the males being frequently as large as, or even larger than, those of the females. The modifications of the cerci will be described under the discussion of the terminal abdominal structures of both sexes of the Diptera.

3. The terminal abdominal structures of female Diptera

The chief "landmark" for identifying the segments in the posterior region of the abdomen of female Diptera, is the "female gonopore", (*fg* of Fig. 9a) which is located (as it is in other insects) between the eighth and ninth sterna, or behind the eighth sternite; and the statement of Balfour-Browne (1932, p. 172), that "it is generally agreed that the female gonopore in Diptera is situated behind the 9th sternum", is quite misleading. Furthermore, his view that the true first abdominal segment has been absorbed in the metathorax, and that each apparent segment should consequently receive a higher number is erroneous, as is also true of the view of Huckett (1924), who considers that the occurrence of two pairs of spiracles in the sixth segment of the postabdomen of muscoid flies (Fig. 9a, D) indicates that the sixth segment represents the union of the sixth and seventh segments, and that the following segments should therefore receive a higher number, thus erroneously locating the female gonopore behind the ninth sternite in both cases. This somewhat repetitious emphasis of the fact that the female gonopore is located behind the eighth (and not behind the ninth) abdominal sternite, is necessitated by Balfour-Browne's statement that the opposite view is the one generally accepted by dipterists, and if such is the case, every effort should be made to correct such a widespread misconception.

Although the Nematocera do not as a rule exhibit a marked tendency toward the formation of a postabdomen, many primitive orthorrhaphous Brachycera do so, since the membranous intersegmental region is frequently greatly developed in them, and the sclerotized areas representing the tergites and sternites are much reduced in the segments of the posterior region of the abdomen in female orthorrhaphous Brachycera related to the Rhagionidae (Leptidae). These tendencies reach their culmination in the female Muscoidea (Fig. 9a, D), in which the membranous intersegmental regions of the postabdomen are very large, and the sclerotized areas of the tergites and sternites (which may become split longitudinally) are reduced to longitudinal strips (Fig. 9, E), for strengthening the membranes in which they are embedded, and for furnishing supports for the attachment of the muscles operating in the telescoping movements of the egg-laying tube formed by the postabdomen.

The Terminalia of Female Nematocera. The terminalia of the tipulid *Clytocosmus*, shown in Fig. 9, A, may be taken to illustrate the terminal abdominal structures of a primitive type of Nematocera, although the structural details of the terminalia have been more carefully worked out in female culicids of the type described later.

The eighth abdominal tergite or epigynium, *8t* of the tipulid shown in Fig. 9, A, is much reduced in comparison with the tergites of the preceding segments, but the eighth sternite or hypogynium, *8s*, is well developed and projects backward below the postgenital segments. The valves, *hg*, of the eighth sternite are called the hypovalvae or hypogynial valves in the tipulids, in which they form the

so-called sternal valves, valvae inferiores, or "egg-guides" of the egg-laying apparatus (the so-called "ovipositor") whose "tergal valves" are formed by the cerci, *ce*.

The type of egg-laying apparatus described above should be referred to as an oviscapt, or ovicauda, rather than an "ovipositor", in these Diptera, since its parts are not strictly homologous with those of a true ovipositor of the type occurring in orthopteroid insects, in which the ovipositor valves are made up of parts of the modified appendages of the eighth and ninth abdominal segments. The sternal valves, *hq* of the tipulid shown in Fig. 9, A, may possibly be homologous with the ventral valves of a true ovipositor* (although they may be merely secondarily-formed valvular processes of the eighth sternite), but the cerci, *ce*, which form the tergal valves of the so-called ovipositor in the tipulids, are never involved in the formation of the valves of a true ovipositor of the orthopteroid type, etc.; and even in the higher Diptera, the cerci do not, as a rule, form any considerable part of the egg-laying apparatus (though they may possibly do so in the female cyclorrhaphan shown in Fig. 9, D).

In the female tipulids described by Snodgrass (1903), paired sclerites of the eighth sternite, which may unite to form a bifid plate projecting from the floor of the genital chamber, are called the "first gonopophyses" by Snodgrass, who also applies this designation to the anterior, or ventral valves of the true ovipositor of orthopteroid insects.

Snodgrass calls the processes of the ninth sternite the "second gonapophyses" in female tipulids, and also applies this designation to the intermediate valves of the true ovipositor of the orthopteroid insects in which the intermediate (or inner) valves of the ovipositor are appendages of the ninth sternite, but the exact homologies of these structures in the Diptera have not been definitely determined. The parts of the ninth sternite, *9s*, of the tipulid shown in Fig. 9, A, are greatly modified, but in the present state of our knowledge of these structures, it is impossible to interpret them definitely in terms of the parts of orthopteroid insects. The location of the gonopore of the female tipulid shown in Fig. 9, A, is indicated by the label *gpo*.

Snodgrass (1903) finds the representatives of the paraprocts, or parapodial plates of the eleventh segment of orthopteroid insects, in the tipulids described by him; and the bipartite plate below the anal opening, *ao* of the tipulid shown in Fig. 9, A, may bear some relation to the paraprocts, although this has not been definitely determined. Traces of the dividing line between the tenth tergite and the eleventh segment (represented by the plates, etc., at the base of the cerci, *ce*) are retained in the tipulid shown in Fig. 9, A, and this type of female dipteran furnishes an excellent starting point for tracing the gradual fusion of the segments behind the ninth, and their ultimate adhesion to the ninth segment, in the higher Diptera.

The cerci of the tipulids are occasionally of the nature of blunt

* In some tipulids, processes of the ninth sternite may represent the dorsal valves of a true ovipositor.

fleshy lobes, but in the typical tipulids they are slender, pointed, rather strongly sclerotized structures like those of the tipulid shown in Fig. 9, A, and form the dorsal valves of the egg-laying apparatus of these Diptera. This type of one-segmented cerci, bearing lateral ridges or flanges, is remarkably similar to the one-segmented cerci of the mecopteron *Boreus*, and the similar modificational tendencies exhibited in the Mecoptera and Diptera in most of the structures of the body clearly point to a mecopteroid ancestry for the Diptera.

It is very surprising that the cerci of the Nematocera are usually composed of but one segment, even in the females, in which the cerci are better developed than in the males; but some female Nematocera have retained the two-segmented condition typical of most Mecoptera, as is the case in the fossil tanyderid *Macrochile* figured in Plate I of the paper by Crampton (1926b), and in certain female mycetophilids such as *Macrocera*, etc. The two-segmented cerci may be retained even in such "higher" forms as the rhagionids (leptids) and stratiomyids (Fig. 9, G), however, and in the latter insects they are slender structures very suggestive of the cerci of typical Mecoptera. According to Metcalf (1921), the cerci are also two-segmented in the syrphid *Chrysogaster pulchella*.

The characters furnished by the terminalia of female mosquitoes are used by Gerry (1932), Christophers (1923) and others for differentiating the genera and even the species of the Culicidae; and it is quite possible that similar characters may prove to be of some taxonomic value in other Nematocera as well, since the culicids are quite primitive Diptera and are fairly typical Nematocera. The parts have been studied quite thoroughly in female mosquitoes, and the structural details presented by the female culicids will serve to illustrate the structural details of a typical female nematoceran in the following discussion.

As is shown by Christophers (1923) in female mosquitoes, the common oviduct, the spermathecal duct, and the terminal pouch of the mucous gland, open into the so-called atrium, *at* of Fig. 9, C, or genital chamber situated between the eighth and ninth abdominal sternites. The atrium, *at*, is bordered by a preatrial sclerite, *pra*, belonging to the eighth sternite, and a postatrial sclerite, *poa*, belonging to the ninth sternite; and these two sclerites form the periatrial sclerites. Christophers calls the area *ins* (which frequently bears setae, etc.) the insula, and designates the area *co* as the "cowl", while the plates *ap*, which are apparently parts of the ninth sternite, are called the atrial plates by him.

The composite plate, *pgp*, which may contain the eleventh and tenth sternites according to Gerry (1932), is called the postgenital plate by him. The ninth and tenth tergites are represented by narrow transverse sclerites in the lower culicids, but the tenth tergite becomes atrophied in the higher culicids. The cerci, *ce*, are composed of a single segment, and are broad lobe-like structures in the typical culicids.

The Terminalia of Female Orthorrhaphous Brachycera. In the

female rhagionid (leptid) shown in Fig. 9, F, the segments of the postabdomen have become slender and are widely spaced, with membranous intersegmental regions, *is*, between them, to permit a telescoping of the segments which is very suggestive of the condition exhibited in females of the muscoid Cyclorrhapha.

The hypogynium, or sternite of the eighth segment, *8s*, projects posteriorly beneath the ninth segment in the rhagionid (leptid) shown in Fig. 9, F, in a manner rather characteristic of the lower Brachycera, but not so prominently as in the stratiomyid shown in Fig. 9, B. The ninth and apparent tenth segments are still distinct in the rhagionid (leptid) shown in Fig. 9, F (and to some extent in the stratiomyid shown in Fig. 9, B); but the apparent tenth segment is probably a composite "segment" composed of the true tenth segment and the cerci-bearing eleventh segment (with the telson) which unite to form the proctiger, *pgr*, or "anal segment". The dorsal plate, *epr*, of the proctiger of the stratiomyid shown in Fig. 9, B and G, is called the supra-anal plate (epiproct) and its ventral plate, *hpr*, is called the subanal plate, or hypoproct. (Compare also the so-called postgenital plate described by Gerry, 1932.)

The cerci are two-segmented in the rhagionid shown in Fig. 9, F, and are composed of a broad basal segment or basicercus, *bc*, and a smaller distal segment, or disticercus, which bears what appears to be a sense organ near its caudal margin. The two-segmented cerci, *ce*, of the stratiomyid shown in Fig. 9, B and G, are slender and cylindrical, and resemble the cerci of certain Mecoptera in many respects.

In the female asilid shown in Fig. 10, G, the eighth sternite, *8s*, projects posteriorly beneath the ninth segment in a manner rather typical of certain lower Brachycera. The ninth tergite is divided into hemitergites, bearing stout spine-like structures. Hardy, 1935 (Annals and Magazine of Nat. History for 1935, Ser. 10, Vol. xvi, p. 425) figures similar spine-bearing plates called acanthophorites in the dolichopodid *Sciapus* and compares them with the acanthophorites of the Asiloidea with reduced and modified spines which he further compares with "the spines on the (apparent) lamellae of the *Proctacanthus*-group within the Asilinae." Spine-bearing structures occur in the terminal abdominal region of the peculiar fly *Lampromyia* (usually classed with the "Leptidae") and may indicate that this fly is an asilid—as is also true of the thoracic sclerites and other features which ally *Lampromyia* much more closely with the asilids of the *Leptopteromyia* and *Leptogaster* types (in which the wings are very like those of *Lampromyia*) than with the "leptids". Certain therevids also have spine-bearing structures in the posterior abdominal region, and the occurrence of these structures in female therevids, asilids, dolichopodids, etc., is apparently of considerable phylogenetic importance in pointing to a therevid-like ancestry for these forms (rather than a rhagionid ancestry, from which the stratiomyids, tabanids, pantophthalmids, etc., arose), although the lines of descent of the therevids and rhagionids merge at the base of the common stem of the Brachycera in general.

The Postabdomen of Female Cyclorrhapha. In the female muscoid flies shown in Fig. 9, E, and Fig. 9a, D, the segments of the postabdomen are extremely slender, and form a telescopic, egg-laying tube (oviscapt or ovicauda) typical of muscoid flies in general.* The tergites of the sixth, seventh and eighth abdominal segments are represented by two slender, longitudinal sclerites, while each of the slender sixth and seventh sternites is reduced to a slender median sclerite, and the eighth sternite is represented by a pair of slender longitudinal sclerites, in the female housefly shown in Fig. 9, E, as is also the case in the segments of the postabdomen of the female anthomyids described by Huckett (1921-1924).

The eighth sternite of female muscoid flies does not, as a rule, project posteriorly to form a hypogynium of the type occurring in the orthorrhaphous Brachycera described above, and the ninth segment tends to unite somewhat more closely with the proctiger, or "anal segment", in female Muscoidea, than is the case in the Brachycera mentioned above. The cerci of a female housefly are one-segmented, lobe-like structures; and in most Cyclorrhapha the cerci appear to be reduced to a single segment.

In the female calobatid shown in Fig. 10, F, the apparent "segment" behind the sixth is modified to form a strongly sclerotized caudal region, which is broad basally and tapers posteriorly, and is probably used in oviposition. In the trupaneid fly shown in Fig. 9, D, the apparent segment behind the sixth, becomes modified to form a sclerotized tube into which the terminal segments, which (with the cerci) are modified for piercing, are retracted; and in other trupaneids such as *Toxotrypanea curvicauda*, the apparent seventh segment of the female forms an elongated sharply curved structure which is longer than the rest of the body.

Loew (1862, p. xv) refers to the egg-laying apparatus of such Diptera as those mentioned above, as the "ovipositor", and states that such an "ovipositor" is called "according to its form either the borer (terebra) or the style (stylus)." Such an "ovipositor", however, is not homologous with the terebra of Hymenoptera and other insects; and the slender terminal portion, called the stylus by Lowe, is not homologous with numerous other structures to which the designation style, or stylus, is applied. It is therefore inadvisable to apply the designation terebra or style, to these structures in female Diptera; and, as was mentioned above, the egg-laying apparatus of the Diptera is not homologous with an ovipositor of the orthopteroid type, so that it is preferable to discard such terms as stylus, terebra, ovipositor, etc., for these structures in the Diptera, in favor of such designations as oviscapt, or ovicauda, etc., for the parts in question.

4. The terminal abdominal structures of male Diptera

In most Nematocera and other lower Diptera, the segments anterior to the genital segments do not as a rule differ markedly from

*According to Berlese (1902) the postabdomen of the female housefly plays an important rôle in the mating process.

the segments preceding them, but as we pass to the Brachycera whose lines of descent approach those of the Cyclorrhapha, we frequently encounter instances of a modification of the eighth segment (Fig. 12, A) as well as the seventh segment (Fig. 12, C) and even the sixth segment (Fig. 10, D), to form a rather imperfectly differentiated postabdomen, which may even undergo a "preliminary" distortion (Fig. 12, B) foreshadowing the modifications which reach their final culmination in the distorted postabdomen of male Cyclorrhapha.

The Parts of the Male Genital Segment. The ninth segment of the male exhibits the greatest variability, and its structures are consequently of great taxonomic value in most male Diptera. The problem of determining the homologies of the male genitalia, however, is an extremely difficult one (as is the case with the male genitalia of insects in general), and much work remains to be done before a uniform terminology can be successfully applied to the genitalic structures in all male Diptera.

Despite the contentions of other investigators to the contrary, the writer would vigorously insist that if comparative morphology has any meaning at all, the segmented genital forceps flanking the aedeagus in male Mecoptera, Trichoptera, Diptera, etc., must be homologous with the genital forceps, or parameres, flanking the aedeagus in male Hymenoptera, Coleoptera, etc., instead of representing the coxites and styli of lower insects, as is maintained by other investigators. The ontogenetic development of the parts, so far as they have been studied, may readily be interpreted as supporting this view, and it is very difficult to understand why the segmented genital forceps of male Diptera, Mecoptera, etc., which are strikingly similar to those of the closely related Hymenoptera, are not interpreted alike in these closely related Holometabola!

Ontogenetically, the aedeagus and parameres develop from paired lobes borne on the ninth sternite in the immature stages of male Holometabola, and these lobes become differentiated into the structures forming the median aedeagus, with its flanking parameres borne on a basal ring, in the adult. The flanking parameres, borne on a very broad basal ring, are unsegmented in such primitive Holometabola as the lampyrid beetle *Lucidota corrusca*, while in the primitive hymenopteron *Xyela*, the basal ring becomes greatly reduced in size, and the formerly unsegmented parameres now become two-segmented genital forceps flanking the median aedeagus formed by the union of the paired penis valves, or aedeagal valves, which unite to form the sclerotized tube through which the ejaculatory duct opens to the exterior (frequently by means of a membranous eversible penis). In the Trichoptera, Mecoptera, Diptera, etc., the basal ring is usually obliterated, and the parameres, which are usually two-segmented in the primitive representatives of these orders, form the genital forceps flanking the median aedeagus, as was pointed out by the writer in Vol. 23, page 3, of the Bulletin of the Brooklyn Entomological Society for 1938.* The basal segments of the genital forceps will be

* See also the recent discussion of these structures in male Diptera in the September issue of "Psyche" for 1941.

termed the basimeres or basistyles, and the distal segments of the genital forceps will be termed the distimeres or dististyles in the following discussion of the modifications of the segments of the parameres in different male Diptera.

The segments of the forcipate parameres are slender in male Culicidae (Fig. 7, H, *cxi* and *st*), Ptychopteridae (Fig. 10, K, *cxi* and *st*), certain Tipulidae (in which family the distimeres are usually divided into an inner and outer portion labelled *in* and *ot* in Fig. 7, J), Trichoceridae, Tanyderidae, and other primitive Nematocera, and the basimeres tend to unite with the ninth sternite even in the lower Nematocera. As we pass to the Bibionidae (Fig. 12, G), Leptidae (Fig. 12, A) and other intermediate forms, the basimeres, *cxi*, become shorter and stouter (and apparently unite with the ninth sternite); and in the stratiomyid *Ptecticus*, shown in Fig. 12, C, the distimeres *st* become broad and flat, as they do in the syrphid *Syrphus rectus* shown in Fig. 14, H (where the distimeres are labelled *st*), and the reduced basimeres *cxi* of *Ptecticus* (Fig. 12, C) unite with the ninth sternite as the basimeres *cxi* do in *Syrphus rectus* (Fig. 14, H). The so-called anterior and posterior gonapophyses *ago* and *pgo* of the higher Cyclorrhapha such as *Hylemyia antiqua* (Fig. 13, D) flanking the base of the aedeagus *pha* were formerly homologized with the segments of the genital forceps of lower Diptera by the writer, but this view is apparently incorrect, as will be discussed later on.

The ninth abdominal tergite (a sternite according to Cole, 1927) which apparently unites with the eighth tergite in the ptychopterid *Bittacomorpha* (Fig. 10, K) bears a pair of long slender processes, *ss*, called surstyli in lower insects. These may correspond to the processes of the ninth tergite labelled *ss* in Fig. 12, C, of the stratiomyid *Ptecticus*, and these in turn may correspond to the articulated surstyli *ss* borne on the ninth tergite of the Syrphidae (Fig. 12, F), which have been homologized with the surstyli or edita *ss* of the higher Cyclorrhapha shown in Fig. 13, D, E and F, etc., in which these structures are greatly developed to aid in mating (and are rather closely associated with the cerci).

The Postgenital Structures of Male Diptera. The postgenital segmental complex forming the so-called "anal segment" or proctiger is small and inconspicuous in most male Diptera. It is closely associated with the ninth tergite, by which it is concealed in most of the lower Diptera, but in the higher Diptera (in which the cerci are thrust downward and forward against the surstyli) the proctiger becomes more exposed to permit the free discharge of the faeces at all times, even in copula.

The proctiger or "anal segment" is here regarded as composed of the united tenth and the cercus-bearing eleventh segment (with which the anus-bearing telson has fused), although Snodgrass (1935), and most other investigators, refer to it as the tenth segment alone; and Snodgrass refers to its appendages as the lobes of the tenth segment (socii?), instead of cerci, since he considers that the cerci are absent in the Diptera. Christophers (1923), however, in tracing the

development of the cerci in both sexes of the mosquitoes, finds that there are true cerci in the male as well as in the female, and there is every reason to believe that the cerci of other male Diptera in general are homologous with the cerci of the females, as is the case in the mosquitoes. Furthermore, the cerci of female mosquitoes (and their homologues in the male) are clearly homologous with those of other primitive female Diptera in which the cerci are borne on a reduced eleventh segment (as in Fig. 9, A), comparable in every way to the cerci of female Mecoptera, in which the cerci are borne on a distinct eleventh segment (although the eleventh segment also unites with the tenth in male Mecoptera), as they are in both sexes of the lower insects, in some of which, however, the cercus-bearing eleventh segment also tends to unite with the tenth segment even in these primitive forms, so that it is not surprising that the eleventh segment tends to unite with the tenth in male Diptera!

The cerci are one-segmented in male Diptera, and are usually relatively smaller in male Nematocera than in male Cyclorrhapha, in which they are associated with the surstyli in mating, and apparently have a sensory function. They are frequently hugely developed in male Dolichopodidae (Fig. 10, D), and may be strikingly modified in these insects.

Inversion and Torsion of the Male Terminalia. There are two principal types of permanent inversion of the genital segments (with the proctiger) in male Diptera, in both of which types the ninth sternite takes up a dorsal position, and the ninth tergite assumes a ventral position, but the direction in which the aedeagus, etc., project after the inversion is quite different in the two types, because of the difference in the processes by which the two types of inversion are brought about.

The first type of inversion may be illustrated by the male mosquito shown in Fig. 11, B, in which the inversion takes place when the parts rotate about the long axis of the body, through 180 degrees; and the direction of the rotation is indicated by the looping up of the ejaculatory duct from left to right over the top of the hindgut. The designation "rotation" should be restricted to such a turning of the segments about the long axis of the body, and the resulting inversion may be spoken of as a rotary inversion (or "transinversion"). After a rotary inversion has taken place, the inverted aedeagus, genital forceps, proctiger, etc., are still directed approximately straight back along the long axis of the body. This type of inversion takes place just after the insect emerges from the pupal stage in certain Tipulidae, Culicidae, etc.

Edwards (1924) describes a permanent inversion of the ninth segment (with the proctiger) in the tipulid *Styringomyia*, and also states (on page 265) that "the occurrence of this torsion is rare in the Tipulidae, occurring only, so far as I am aware, in the genera Molophilus and Amphineurus, and in an incomplete form in Micromastix." The writer has observed an inversion of the ninth segment (and proctiger) in the primitive tanyderid *Protoplasa fitchii*, and an

inversion of the parts has been recorded for some dixids, chironomids, culicids, phlebotomine psychodids, mycetophilids, etc., among the Nematocera, while in the orthorrhaphous Brachycera, such asilids as *Dasyllis* and *Laphria* have the eighth and ninth segments (with the proctiger) temporarily inverted during copulation.

In the second type of inversion, which may be spoken of as a torsion inversion (or "retroinversion"), the inversion results from a torsion or winding of the parts forward and around along the sagittal plane of the body, as in the insects shown in Fig. 12, E and I, (compare also Fig. 12, B), as though it were an arrested stage in the so-called circumversion of the ninth segment (with the proctiger), which takes place in the pupal stage of such Cyclorrhapha as *Calliphora*. In this type of inversion, the aedeagus and other structures are directed more nearly downward and forward than backward (as they are in the rotary type of inversion).

The torsion process is apparently initiated by the setting out of the ninth segment (with the proctiger) to undergo a "circumversion", which probably takes place by a turning of the parts forward and around along the sagittal plane of the body, and the process is continued until the ninth segment and proctiger almost complete the circumversion, although they do not completely revert to their original position, since the aedeagus, etc., project downward and forward (as in Figs. 13 and 14) instead of backward, as they do in the lower Diptera shown in Fig. 12, C, G, etc., in which the parts remain in their original position.

As the ninth segment winds around, it apparently drags up the eighth sternite into the insect's left side, and on over into the dorsal region where it becomes inverted in the distorted postabdomen of male Cyclorrhapha. The seventh sternite is apparently dragged up into the insect's left side, following the eighth sternite, and becoming strongly asymmetrical. Finally, the sixth sternite may become displaced into the insect's left side, but the sixth tergite is less affected by the torsion process than the seventh and eighth tergites are, since these may become vestigial or atrophied, although their ultimate fate is not clear from the material at hand.

A torsion of the parts occurs in some Dolichopodidae and Empidae, and in certain Bombyliidae and Cyrtidae, etc., as well as in the Phoridae and Lonchopteridae which approach (or may be included among) the Cyclorrhapha, in which the torsion tendency reaches its final culmination and affects all of the males of this suborder. The torsion exhibited by such dolichopodids as the one shown in Fig. 12, B, (compare also Fig. 10, D) is particularly suggestive of a foreshadowing of the more pronounced torsion occurring in male Cyclorrhapha, and a study of these dolichopodids is of considerable interest since it suggests how the torsion process began in the lower forms.

Since the twisting of the terminalia is always from left to right (as is shown by the looping up of the ejaculatory duct from left to right over the top of the hindgut) in the lower as well as in the higher Diptera, it is possible that we are dealing with a fundamental

tendency (or genetic factor) present, though latent, in most male Diptera, but finding opportunity for expression (or the right genetic conditions) here and there in scattered instances, until finally it finds opportunity for full expression in all male Cyclorrhapha. The value (if any) afforded its possessor by such a peculiar distortion is problematic, and it is conceivable that the males in which such an apparent malformation occurs could survive despite it, if they possessed other compensating advantages. On the other hand, the universal occurrence of this distortion throughout the highly successful group Cyclorrhapha, and the occurrence of a permanent rotation in many other forms, together with the ability of many male Diptera to twist the parts about temporarily in mating, suggest that such modifications may aid in the mating process, in which the participants assume the diverse positions described by Hardy (1935) and Gruhl (1924), and these modifications may therefore have some survival value for the race.

Recent investigators, particularly the taxonomists, are reluctant to accept the view that there has been a profound torsion of the terminalia in all higher Diptera, but the proofs for its occurrence are very convincing to the student of comparative morphology. Males of the higher Diptera furnish striking series of intergrading forms illustrating various stages in the development of the distortion and dislocation of the sclerites (particularly the sternites), and this evidence is amply substantiated by the ventral shift of the dextral spiracles of the seventh and other segments into the ventral region (Fig. 12, D and H), and is further confirmed by the distortion and displacement of the tracheae. Still further proof of the occurrence of a torsion of the terminalia of male Cyclorrhapha is furnished by the looping up of the ejaculatory duct, etc., from left to right (as the dislocation of the sclerites indicates must have occurred) over the top of the hindgut in all male Cyclorrhapha thus far studied (see Fig. 9a, A, and Fig. 14, H), and the torsion of the parts has been seen to occur in the pupal stage of *Calliphora*, by Schraeder (1927), although he did not realize all of its implications, or interpret the dislocated sternites correctly.*

The Terminalia of Male Nematocera. In some male Nematocera, such as the Tipulidae, the eighth segment may be differentiated from the preceding ones in size or shape, or in the character of the processes, tufts of hair, etc., that it bears, and in such cases the eighth segment is considered as one of the genital segments of the male hypopygium. The ninth segment, however, is the one which is the most strikingly modified, and its parts furnish the characters of the greatest taxonomic value.

The ninth sternite (hypandrium) is well developed in such Nematocera as the Trichoceridae, limnobiine Tipulidae, etc., but in most

* It is difficult to explain the lack of visible evidence of distorsion in the longitudinal intersegmental muscles of *Calliphora*, unless certain muscles form anew after the torsion, and those connecting the tergites (which do not shift when the sternites do) would naturally remain unaffected by the torsion.

Psychodidae, and in certain Mycetophilidae, etc., it becomes atrophied. In the tipulid genus *Tipula* (Fig. 10, A) and in many Mycetophilidae, etc., the ninth sternite is large and tends to unite with the basal segments of the genital forceps. In the Trichoceridae, on the other hand, and in such tipulids as *Macrocera* and in the tanyderid *Tanyderus forcipatus*, the ninth sternite is separate from the basal segments of the genital forceps, which, however, tend to unite basally in these Diptera. Since the genital forceps represent forcipate parameres (instead of coxites and styli as de Meijere, 1919, and other recent investigators maintain) their segments may be referred to as the basimeres and distimeres to indicate this fact. The descriptive designations basistyles and dististyles have long been applied to the basal and distal segments of the genital forceps in male Nematocera, however, and there can be no serious objections to the use of these terms in referring to the parts in male Nematocera.

In the tipulid shown in Fig. 7, J, the "basistyles", *cxi*, do not unite with the ninth sternite, but are distinct, elongated structures like those of the culicid shown in Fig. 7, H (compare also Fig. 11, A). In the tipulid shown in Fig. 7, J, the "basistyles" bear mesal processes, *ib*, called interbases, and the "dististyles" are divided into an outer portion, *ot*, and an inner portion, *in*, called the outer and inner dististyle by Alexander. Although the division of the "dististyle" into an outer and inner dististyle is quite characteristic of the Tipulidae, it rarely occurs outside of this family of Nematocera, although certain Trichoceridae and the fossil tanyderid *Macrochile* have a forked dististyle, from which type the divided dististyles may have evolved through a deepening of the fork and a separation of its arms. In the recent tanyderid genus *Peringueyomyina*, the basistyles and dististyles are extremely slender and elongated, and attain the greatest length occurring in any of the Diptera.

In discussing the structural details of the parts of the ninth segment, etc., in the males of the lower Diptera, the condition occurring in a typical culicid, such as the one shown in Fig. 11, A, will serve to illustrate the character of the parts in a typical male nematoceran, since the structures of the ninth segment are quite well developed in male culicids, and considerable attention has been given to the structures of these insects because of their economic importance. The following description of the parts of the ninth segment of a male mosquito is based upon the work of Edwards (1920), Matheson (1929), Freeborn (1924), and Herms (1939), whose terminology has also been adopted here with a few changes to bring it into harmony with the usage of other entomologists. The terms applied to the parts by other investigators are also listed for comparison.

The inversion of the ninth segment* (and proctiger) in male mosquitoes is shown in Fig. 11, B, which is taken from the paper by Edwards (1920), who has corrected his own earlier misconceptions in the matter, and also the misinterpretations of Brolemann (1919) and other earlier investigators who did not realize that an inversion

* According to Christophers, the eighth segment is also inverted in male mosquitoes.

of the ninth segment (and proctiger) occurs in male mosquitoes. As Edwards points out, this inversion takes place within a few hours after the male mosquito emerges from the pupal stage, as the result of a rotation of the parts about the long axis of the body, through 180 degrees. As the result of the inversion, the ninth sternite, for example, now becomes dorsal in position, and the ninth tergite becomes ventral in position, but the tergite and sternite are still referred to as such, despite their displacement.

The ninth segment may form a more or less continuous sclerotized ring in male culicids, but the ninth tergite (which is secondarily ventral in position) is usually demarked from the ninth sternite (which is secondarily dorsal in position) by slight constrictions, or by faint sutures, etc. The ninth tergite may bear a pair of tergal lobes, labelled *tl* in Fig. 11, A, which are called setaceous lobes by Felt (1905), or the basal appendages by Howard, Dyar and Knab (1912); and these structures are of some value in classification. The ninth sternite usually exhibits fewer modifications of taxonomic value than the ninth tergite does.

The genital forceps or forcipate parameres are composed of two segments, namely a basal segment, *cxi*, called the "basistyle" or basimere, and a distal segment, *st*, called the "dististyle", or distimere. The distal segment of the forceps, *st*, bears a terminal claw-like appendage, labelled *cla* in Fig. 11, A, which may represent a modified second segment of the distimere or dististyle.

The basal segment of the genital forceps, labelled *cxi* in Fig. 11, A, is called the coxite by de Meijere (1919), the basistyle by Crampton (1923), the gonostipes by Cole (1927), the "side piece" by Dyar and Knab (1909), the basal clasp segment by Felt (1905), the basal joint of the superior clasper by Newstead (1911), the basal lobe by Nuttall and Shipley (1901), the pleurum by Snodgrass (1904), the coxopodite by Snodgrass (1935), and the harpagoger in recent papers.

The distal segment or clasper of the genital forceps, labelled *st* in Fig. 11, A, is called the stylus by de Meijere (1919), the dististyle by Crampton (1923), the clasp filament by Howard, Dyar and Knab (1912), the terminal clasp segment by Felt (1905), the clasper by Nuttall and Shipley (1903), the apical appendage by Snodgrass (1904), the stylus by Snodgrass (1935), and the harpago in recent publications. The designation harpe is also applied to this structure by some entomologists.

The lobes labelled *alb* and *bal* in Fig. 11, A, are called the apical and basal lobes (of the basimere or "basistyle"), and the U-shaped folds, *ibf*, are called the interbasal folds by Freeborn (1924), while their processes, *cp*, called the claspettes by Edwards (1920), correspond to the structures called the "harpagones" by Howard, Dyar and Knab (1912), or to those called the harpes (in part) by Felt (1905). The designations harpes and harpagones, however, are applied to the distal segments of the genital forceps of other insects, including the nematocerous Diptera, and it is very confusing to at-

tempt to determine what structures are meant when the designations harpes or harpagones are used in the descriptions of male Nematocera, so that Edwards' term claspettes should be used for these structures (i.e., *cp* of Fig. 11, A) in male mosquitoes, until the proper application of the terms harpes and harpagones has been determined for insects in general and the Culicidae in particular.

The basal segment of the genital forceps bears a mesal and lateral apodeme in male mosquitoes, and Matheson (1929), who describes the parts in a typical male mosquito belonging to the genus *Aedes*, applies the designation basal plate to the structure labelled *bap* in Fig. 11, A, and calls the sclerite labelled *pam*, the "paramere". Edwards (1920) states that the "paramere" corresponds to the "first plate of the unci" of Dyar (1918), and the trigonapophyses of Brolemann (1919), and to the gonapophyses of de Meijere (1919).

The above-mentioned applications of the terms parameres and gonapophyses to structures wholly different from those designated as parameres and gonapophyses by other entomologists is deplorably confusing, since no one can be quite sure what structures are meant when these terms are used by different entomologists. It is therefore very strongly urged that the term parameres be restricted to the genital forceps (composed of the basimeres and distimeres) of lower Diptera, in which these structures are homologous with the genital forceps, or segmented parameres, of male Hymenoptera, or the unsegmented parameres of male Coleoptera (to which the term parameres was first applied by Verhoeff)—and the genital forceps labelled *cxi* and *st* in Fig. 11, A, of a male mosquito, are the structures homologous with the parameres of other insects, so that the designation parameres should be applied to these structures, alone, in male mosquitoes as well.

The term gonapophyses is very loosely used by entomologists, being applied by them to parts ranging from the valves of the ovipositor of the female in lower insects (and the sternal processes of female Tipulidae) to the structures flanking the base of the aedeagus in male muscoid Diptera (i. e., the so-called anterior and posterior gonapophyses, which are also called parameres in male Cyclorrhapha); and the term gonapophyses is therefore a more or less general designation referring to different genital processes. If the term gonapophyses is used by dipterists, it is suggested that it be restricted to the anterior and posterior gonapophyses *ago* and *pgo* of male Cyclorrhapha (e. g., those shown in Fig. 13, D, E, etc.), although it is also suggested that these structures be called the pregonites and postgonites (for the sake of brevity): and it is suggested that the structures labelled *pam*, *ga*, etc., in the male mosquito shown in Fig. 11, A, be called endomeres, as a purely descriptive designation, since they are definitely not parameres.*

The external sclerotized portion of the genital tube forming the

* Much more thorough and extensive work must be carried out before a uniform terminology can be applied to the parts in all male Diptera, and it is to be hoped that the investigations of the parts in male Diptera in general, now being carried out by Mr. R. E. Snodgrass, will soon be published to be made available for this purpose.

male organ, labelled *ae* in the male mosquito shown in Fig. 11, A, appears to be homologous with the structure called the aedeagus in male insects in general. Older writers refer to it as the penis (a term restricted by recent entomologists to the membranous eversible structure through which the ejaculatory duct discharges to the exterior), while many recent culicidologists such as Freeborn (1924) and others, follow Christophers (1922) in calling it the phallosome, although Alexander and other students of the Tipulidae restrict the term phallosome to the structure labelled *phs* at the base of the aedeagus *ae* of the male tipulid shown in Fig. 7, J, and the latter usage has much to recommend it. Edwards (1920) suggests that it be called the mesosome (as proposed by Waterston, 1914) instead of phallosome, and states that it corresponds to the structure called the theca by Christophers (1922)—a term applied to a wide variety of structures in other insects. Although there can be no serious objection to calling the male organ *ae* of a male mosquito (Fig. 11, A) the phallosome, it is preferable to refer to it as the aedeagus, in conformity with the general application of this term in other insects.

The so-called "tenth segment" of male culicids is apparently a composite structure formed by the union of the tenth segment, the cercus-bearing eleventh segment, and the anus-bearing, non-segmental telson. If the appendages it bears are formed by the cerci (as Christophers, 1923, maintains), the cercus-bearing eleventh segment is probably involved in its composition, so that it is inadvisable to refer to it as the "tenth segment" or the "anal segment". Since it is apparently a segmental complex, it should be designated as the proctiger, or anus-bearing segmental complex which is referred to by this name in lower insects.

The structures labelled *pr* in Fig. 11, A, are apparently formed, at least in part, by the cerci, since Christophers (1923) has shown that their distal portions, at least, correspond to the cerci of female mosquitoes. Freeborn (1924), on the other hand, refers to these structures as the paraprocts or parapodial plates, although the occurrence of distinct paraprocts in the Diptera has not yet been definitely demonstrated. While it is quite possible that the paraprocts may enter into the composition of the structures in question, it is also quite possible that the paraprocts may form the bipartite plate in the ventral region of the "anal segment" of certain Nematocera, and until the homologies of these structures have been definitely determined, it is preferable to refer to the structures labelled *pr* in Fig. 11, A, simply as the "cerci".

The Terminalia of Male Orthorrhaphous Brachycera. The Rhagionidae (Leptidae) and Therevidae are the most primitive representatives of the orthorrhaphous Brachycera, and have retained many of the characters of the Anisopodidae, Bibionidae and Mycetophilidae, which approach the lower Brachycera in many respects. The genital forceps *cxi* and *st* of the rhagionid shown in Fig. 12, A, are not very different from those of typical male Nematocera; and even in some of the higher members of the orthorrhaphous Brachycera (e. g., the

Bombyliidae, etc.) it is easy to recognize the genital forceps as such, although in the Cyclorrhapha structures homologous with the genital forceps have not been definitely identified.

The Asilidae are of particular interest, since the eighth and ninth segments (with the proctiger) become temporarily inverted in such asilids as *Dasyllis* and *Laphria*, and structures which appear to represent the segments of the genital forceps, labelled *cxi* and *st*, are well developed in such asilids as the one shown in Fig. 10, N. Certain of the appendages of the ninth tergite, *9t*, of the asilid shown in Fig. 10, N, may represent the surstyli, *ss*, of such primitive Nematocera as the one shown in Fig. 10, K, and these appendages become of increasing importance in the types ancestral to the Cyclorrhapha, in which group the surstyli are well developed.

The Dolichopodidae are among the most important of the orthorrhaphous Brachycera which approach the lines of descent of the Cyclorrhapha, and the abdominal structures of the Dolichopodidae, like those of other regions of the body in these interesting Diptera, present some extremely interesting modifications. Thus, in the dolichopodid, *Scellus venustus*, shown in Fig. 10, M, a pair of delicate ribbon-like spatulate processes attached in front of the sixth sternite, extends upward, one on each side of the sixth tergite, from which they project backward as delicate processes bearing long mesal setae at their tips. The function of these processes has not been definitely determined, although they are evidently secondary sexual characters of the male.

Another interesting modification is exhibited by the dolichopodid, *Dolichopus fulvipes*, shown in Fig. 10, D, which has a membranous, ventral, bilobed sac, bearing the label *ev* in Fig. 10, D. This structure appears to be of the nature of an eversible "scent sac", which is protruded at the time of mating, although its function has not been definitely determined. Eversible sacs also occur in the abdominal region of the males of some Empidae and a few other Diptera.

The cerci are much better developed in the males than in the females in the Dolichopodidae, and in the male dolichopodid shown in Fig. 10, D, the cerci, *ce*, are broad, flat, fan-like, fringed plates, while in the dolichopodid, *Liancalus hydrophilus*, figured by Snodgrass (1904), structures which appear to be homologous with the cerci (or surstyli?) project forward as long slender processes extending to the ventral region of the thorax in this insect.

In some Dolichopodidae in which a torsion of the postabdomen occurs, the cavity of the body opens into the eighth segment through an aperture situated on the left side, instead of being located anteriorly as is usually the case; and the terminal abdominal structures of the Dolichopodidae are of great interest for the study of the modifications occurring in the Cyclorrhapha, as will be discussed later.

In addition to the Dolichopodidae, Asilidae, etc., which in some cases exhibit a marked torsion in the segments of the postabdomen (most male Diptera are apparently capable of twisting the parts about temporarily during the mating process), other Brachycera such

as certain Bombyliidae, Cyrtidae, etc., exhibit a similar modificational tendency, as is also the case with the Phoridae and Lonchopteridae, which occupy a "border-line" position between the orthorrhaphous Brachycera and the Cyclorrhapha, being grouped with the orthorrhaphous Brachycera by some dipterists, while they are grouped with the Cyclorrhapha by others. We thus have clear-cut evidence of a tendency to develop the "torsional" modifications characteristic of the Cyclorrhapha occurring in their brachyceran precursors (especially in the Dolichopodidae), and a study of these forms readily reveals how these modifications of the parts in male Cyclorrhapha may have arisen.

The designation "torsion", as used above, is restricted to the distortion and displacement of the segments instituted by the winding movement or "strophe" of the ninth segment (with the proctiger) which takes place along the sagittal plane of the insect's body, as in the dolichopodid shown in Fig. 12, B, and in certain Cyclorrhapha, etc. A "torsion" thus differs from a "rotation", since the latter term is restricted to a rotation around the long axis of the insect's body, and may involve only the ninth segment, with the proctiger, although the eighth segment may also be involved, as is the case in certain asilids, etc., but in such instances the eighth segment rotates with the ninth (and proctiger) as a unit, and does not lag behind the ninth segment as it does in the torsion movements.

The torsion inversion of the ninth segment and proctiger of the insects shown in Fig. 12, E and I, (which differs from the rotation inversion occurring in male mosquitoes, etc.) apparently represents an arrested stage in the so-called circumversion movements of the ninth segment, characteristic of the males of the higher Cyclorrhapha; and the ninth segment tends to become rigid in the inverted stage in the insects shown in Fig. 12, E and I. In the male syrphids shown in Fig. 12, D and F, Fig. 13, A, etc., the circumversion tendency is continued until the ninth segment hangs down loosely and projects laterally or three quarters backward, but the ninth segment does not complete the circumversion as it tends to do in the higher Cyclorrhapha, so that we may speak of its twisting as a "strophe" (from the Greek word meaning a twisting) rather than a circumversion. In the higher Cyclorrhapha shown in Fig. 13, B, D, F, etc., the ninth segment becomes more rigid as it tends to complete its circumversion.

The Terminalia of Male Cyclorrhapha. The following tendencies exhibited by the terminal abdominal structures of male Cyclorrhapha are rather characteristic of the group, although they do not necessarily occur in all of the members of the group. These are as follows: (1) The aedeagus extends forward (or downward) in repose. (2) The ninth segment, together with the proctiger, (i. e., the composite "gonoproct") undergoes a permanent "circumversion" at the time of pupation (?), and the ejaculatory duct becomes looped up from left to right over the top of the hindgut in all male Cyclorrhapha thus far observed. (3) The large sternite of the eighth segment tends to become inverted, and its tergite becomes atrophied.

(4) The sternite of the seventh abdominal segment becomes lateroverted, or drawn up into the insect's left side, and its dextral spiracle may become drawn down into the ventral region. Its tergite becomes vestigial, or is obliterated, or may unite with the synsternite. (5) The lateroverted seventh sternite tends to unite with the inverted eighth sternite to form a synsternite, having the appearance of a tergite. (6) The narrow sixth sternite (bordering a genital pouch in some cases) is frequently asymmetrically developed, and may become attached to the lower sinistral border of the synsternite. The sixth tergite tends to become reduced, but usually remains in place. The dextral spiracle may also shift down into the ventral region. (7) The fifth abdominal sternite may become bilobed posteriorly to form a pair of copulatory lobes or processes, and its tergite forms the last "visible" tergite of the preabdomen in many Cyclorrhapha.

The downward shift of the dextral spiracles (Fig. 12, H and D) and their displaced and distorted tracheae, and the looping up of the ejaculatory duct from left to right over the top of the hindgut (Fig. 9a, A, and Fig. 14, H), should be evidence clear enough to convince anyone that the obvious distortion and displacement of the sclerites in Fig. 10, B, Fig. 12, I, etc., is the result of a left to right torsion; and the shift in the string of consecutive sternal plates in the lower Cyclorrhapha (Fig. 12, F and Fig. 14, H, etc.) clearly indicates a progressive shifting of the sternites, not the tergites, in these forms. The torsion would have to be in the reverse direction (i. e., from right to left), in the face of all the evidence to the contrary cited above, in order to shift any tergites into the position occupied by the obviously displaced sclerites shown in Fig. 10, B, Fig. 12, I, Fig. 13, B and C, etc., which are therefore clearly displaced sternites, not tergites. Furthermore, it is the tergite, not the sternite, which tends to shrink and become vestigial when both are present in the segments of this region. (see Fig. 12, A and C), and it is therefore hardly probable that such a huge sclerite as that labelled *8s* in Fig. 14, H, or Fig. 12, F, etc., for example, represents a tergite instead of a sternite, as other investigators would maintain.

The interpretations given the parts in the following description of the sclerites of male Cyclorrhapha are those suggested by the writer in a brief paper* entitled "Suggestions for a new interpretation of the postabdomen in male cyclorrhaphous Diptera," published in the Bulletin of the Brooklyn Entomological Society, Vol. 31, p. 141, for 1938, although the somewhat "revolutionary" views there proposed are not accepted by other investigators. The views of other writers, and the terms applied by them to the parts in male Cyclorrhapha have also been included in the following discussion, so that the most acceptable interpretations and terminology may be selected after examining the evidence available on the subject.

Starting with the condition exhibited by a lower dipteran such as the bibionid *Dilophus* shown in Fig. 12, G, we note that the ster-

*See also a more recent paper on the terminal abdominal structures of male Diptera, published in the September issue of "Psyche" for 1941, Vol. 48, pp. 79-94.

nite of the eighth segment *8s* is large, and the parts of the ninth segment project directly backward. As we pass to the rhagionid (leptid) type shown in Fig. 12, A, it may be noted that the eighth sternite *8s* is much larger than its tergite *8t*, and the intersegmental membranes become larger and more extensive to permit a greater displacement of the parts in mating, and the ninth segment is able to project upward in this insect. The genital forceps *cxi* and *st* are still clearly recognizable as such, but they tend to unite basally with an area which may possibly represent the remains of the ninth sternite, although this has not been definitely determined.

In a somewhat higher stage represented by the stratiomyid *Ptecticus*, shown in Fig. 12, C, the tergites of the seventh and eighth segments *7t* and *8t* become reduced to small transverse bands, and the eighth sternite *8s* is apparently capable of at least a temporary displacement into the insect's left side during mating; and the ninth segment is capable of projecting dorsally. The ninth tergite *9t* bears a pair of processes *ss* which may represent the surstyli of the higher Diptera. The distal segments or distimeres *st* of the genital forceps are broad and flat in *Ptecticus* (Fig. 12, C) like the apparent distal segments or distimeres *st* of the syrphid cyclorrhaphan shown in Fig. 14, H, and the basal segments or basimeres *cxi* of the genital forceps of *Ptecticus* (Fig. 12, C) unite with the apparent ninth sternite *9s* as the apparent basal segments or basimeres *cxi* do in the syrphid shown in Fig. 14, H. The surstyli *ss* become articulated to the ninth tergite *9t* in the syrphid shown in Fig. 14, H.

An advance in the direction of the development of the cyclorrhaphan type of postabdomen is illustrated by the dolichopodid shown in Fig. 12, B, in which the ninth segment has undergone a partial "circumversion" (or "strophe"), resulting in the dragging up of the eighth sternite *8s* into the insect's left side, although the eighth sternite has not become inverted as it does in many Cyclorrhapha. The seventh segment is somewhat distorted in this dolichopodid and its attachment to the sixth segment indicates that it has been affected by the torsion process. The cerci *ce* are rather suggestive of those of the higher Cyclorrhapha, and structures suggestive of the surstyli *ss* are developed in this dolichopodid, whose aedeagus *ae* projects downward and forward in the cyclorrhaphan manner. The fifth sternite *5s* is likewise cleft posteriorly suggesting the condition occurring in the higher Cyclorrhapha in which the fifth sternite bears copulatory lobes (Fig. 13, E). This dolichopodid thus foreshadows many of the modifications occurring in the higher Cyclorrhapha, although it is not directly ancestral to any of them.

Apparently a pipunculid-syrphid-pyrgotid series may develop in the Cyclorrhapha, since the modifications exhibited by the insects shown in Fig. 12, E and I, are somewhat similar, and the torsion inversion of the ninth segment is of the same type in both insects, but the resemblances are not very close. The character of the narrow, transverse sclerite here interpreted as the vestigial seventh tergite *7t*, which bears the supposed seventh spiracle, and extends

along the anterior margin of the inverted eighth sternite *8s* in Fig. 12, E, suggests that a narrow vestigial seventh tergite, bearing the seventh spiracle, may have fused along the anterior margin of the inverted synsternite, when the seventh sternite united with the eighth sternite to form the synsternite bearing the labels *7s* and *8s* in Fig. 13, D, although the seventh tergite may simply have disappeared in the latter instance.

In the pyrgotid shown in Fig. 12, I, the eighth sternite *8s* shows only a slight tendency to become inverted, and still occupies a ventral position in line with the slightly displaced seventh and sixth sternites *7s* and *6s*, showing that it is a sternite, not a tergite. The eighth sternite is hugely developed and its tergite is lost, thus clearly indicating that the similar large sclerite labelled *8s* in the syrphid shown in Fig. 12, F, is the eighth sternite and not the eighth tergite.

The members of the key group Syrphidae, occupying a position at the base of the lines of descent of the lower Cyclorrhapha, furnish a fairly complete intra-syrphid series or series of forms extending from the less modified to the rather highly modified types of Syrphidae and furnish the key for interpreting the modifications of the sclerites occurring in the higher Cyclorrhapha. In such syrphids as *Heliophilus chaligosa*, the huge eighth sternite has not shifted as far out of the sternal region as it has in the pyrgotid shown in Fig. 12, I, and the eighth tergite becomes vestigial in *Heliophilus*, thus clearly indicating that the large laterally displaced sclerite labelled *8s* in the syrphid *Sericomyia*, shown in Fig. 12, F, is a sternite, and not a tergite—and the torsion would have to be from right to left (instead of being from left to right, as the looping up of the ejaculatory duct *ej* in the syrphid shown in Fig. 14, H, indicates) to cause a tergite to turn over into the insect's left side, and occupy the position assumed by the sclerite labelled *8s* in Fig. 12, F, of *Sericomyia*. The seventh tergite *7t* is hardly displaced in *Sericomyia* (Fig. 12, F) and its spiracle occupies the normal position in relation to the tergite (as do the spiracles of the preceding segments) but the seventh sternite *7s* of *Sericomyia* is slightly lateroverted, or shifted up into the insect's left side, thus tending to follow the migrating eighth sternite *8s*, as it does more pronouncedly in other Cyclorrhapha.

It is important to note that the dextral spiracles are shifted down into the sternal region in the syrphid *Mesograpta*, shown in Fig. 12, D, thus indicating that there has been a profound left to right torsion of the parts, resulting in the shifting of the seventh sternite *7s* up near the large lateroverted eighth sternite *8s* in this syrphid, as is also the case in the syrphid shown in Fig. 14, H; and the sixth sternite *6s* is also very asymmetrical in these syrphids suggesting that a partial suppression may precede the torsion process. The partial "circumversion", or "strophe", of the ninth tergite continues around as we pass from Fig. 12, F, to Fig. 12, D, and Fig. 14, H; and in the highly modified syrphid *Paragus*, shown in Fig. 13, A, the "circumversion" has progressed almost as far as it has in the caelopid shown in Fig. 12, H.

Paragus bicolor, shown in Fig. 13, A, stands almost at the apex of the intra-syrphid series, and its modifications foreshadow many of those occurring in the muscoid series, although *Paragus* exhibits too many specializations of its own to serve as the starting point for the development of the muscoid series. *Paragus* (Fig. 13, A), however, does illustrate very nicely how the lateroverted seventh sternite *7s* (below which lies the displaced dextral spiracle) unites with the inverted eight sternite *8s* (from which it is separated by an incomplete suture) to form a synsternite, as in the higher Cyclorrhapha shown in Fig. 13, C and D; and the sixth sternite *6s* of *Paragus* (Fig. 13, A) is asymmetrically developed, and lies in front of the lateroverted seventh sternite *7s*, much as it does in Fig. 13, B and C, etc.; and the fifth sternite *5s* of *Paragus* (Fig. 13, A) is widely emarginate posteriorly, suggesting the origin of the posterior incision in the fifth sternite of the insects shown in Fig. 13, D and E, which results in the formation of the copulatory lobes *pgl* of the fifth sternite of these insects.

In the stratiomyid *Ptecticus*, shown in Fig. 12, C, the distal segments of the genital forceps, *st*, are broad and flat, and the basal segments, *cxi*, tend to unite with the ninth sternite, *9s*, strongly suggesting the condition exhibited by the structures labelled *st* and *cxi* in the syrphid shown in Fig. 14, H, in which these structures are provisionally interpreted as the modified segments of the genital forceps.

It was formerly suggested by the writer (Crampton, 1936 and 1941) that the gonapophyses *ago* and *pgo* of such higher Diptera as those shown in Fig. 13, D, E, etc., might represent the highly modified segments of the genital forceps, *cxi* and *st*, of such lower forms as those shown in Fig. 12, C, or Fig. 14, H, etc. What appear to be distinct gonapophyses, however, occur in the stratiomyid *Ptecticus*, shown in Fig. 12, C, (where the gonapophyses, labelled *pgo*, are dotted to indicate that they lie within the genital forceps) as well as in certain Therevidae and other forms in which distinct genital forceps (labelled *cxi* and *st* in Fig. 12, C) likewise occur, so that the gonapophyses of the higher Cyclorrhapha can hardly represent the modified segments of the genital forceps of the lower Diptera. It is therefore preferable to refer to the gonapophyses of the higher Diptera simply as the anterior and posterior gonapophyses, although the term "gonapophyses" is rather misleading for these structures of male Diptera, since the designation gonapophyses is usually applied to the parts of the ovipositor, etc., of female insects (in which the parts have no relation to the structures of male Diptera), and the briefer designations pregonites and postgonites are therefore suggested for the structures labelled *ago* and *pgo* in the higher Diptera shown in Fig. 13, D, E, etc.

In the insects shown in Fig. 14, A and C, and in Fig. 10, B and I, the entire sixth segment is little affected by the torsion process, but the seventh sternite *7s* of Fig. 14, C, and Fig. 10, B, becomes strongly lateroverted, and adheres to the inverted eighth sternite *8s* (compare also

Fig. 10, H). The sclerite *7t* interpreted as the seventh tergite in Fig. 14, A, of *Micropeza*, apparently becomes reduced to the small area labelled *7t* in the upper region of the seventh sternite *7s*, which becomes adherent to the inverted eighth sternite *8s* in Fig. 14, C, of *Calobata*. The structures in the ventral region of these insects present some very curious modifications, especially in the region of the fifth sternite.

In the insects shown in Fig. 13, B, C, D, E and F, the sixth tergite *6t* becomes greatly reduced (and may be lost in some of them), but the sixth tergite is not appreciably displaced by the torsion process during which the sixth sternite *6s* (bordering the genital pouch) becomes asymmetrically developed and is eventually captured by the synsternite (formed by the union of the lateroverted seventh and inverted eighth sternites), so that the sixth sternite then appears to be the sternite of a "tergite" formed by the inverted synsternite, as in Fig. 13, F. It is not clear where this series begins, but the condition exhibited by the caelopid *Caelopa*, shown in Fig. 12, H, makes a fairly good starting point for tracing the development of the parts in the series, although *Caelopa* has many modifications of its own, apparently leading off along another line of development.

It is interesting to note that the dextral spiracles of the sixth and seventh segments of *Caelopa* (Fig. 12, H), are shifted down and around into the insect's left side, and the sixth tergite *6t* apparently follows its dextral spiracle around in the shift, while a small plate which may be a vestige of the seventh tergite, also follows its dextral spiracle around into the insect's left side, thus indicating the intensity of the torsion, which is also indicated by the profound distortion and displacement of the sixth and seventh sternites *6s* and *7s*, as these follow the inverted eighth sternite *8s* in the upward shift of the sternites. The ninth segment has almost completed its circumversion in *Caelopa*, but has not yet become rigid, as it does in the higher Cyclorrhapha in which the circumversion is practically completed.

In the series of insects shown in Fig. 13, the parts are retained in a fairly primitive condition by the helomyzid *Neoleria*, shown in Fig. 13, B, in which the sixth tergite *6t* is fairly large and remains practically undisturbed while its asymmetrical, lateroverted sternite *6s* becomes attached by its upper corner to the lateroverted seventh sternite *7s*, which in turn is attached by its upper corner to the inverted eighth sternite *8s* (as though the sternites were being pulled along in a string), and the relations of these lateroverted sternites to each other is much the same as in Fig. 13, A of the syrphid *Paragus*, or Fig. 12, H, of *Caelopa*. The fate of the seventh tergite in Fig. 13, B, is not clear, unless it becomes vestigial and fuses along the anterior border of the inverted eighth sternite *8s* when its sternite *7s* is captured by the eighth sternite.

In the helomyzid *Anorostoma* shown in Fig. 13, C, the union of the sixth, seventh and eighth sternites is carried a step further; and in the helomyzid *Suillia* shown in Fig. 14, D, the distinction between

the lateroverted sixth and seventh sternites *6s* and *7s* becomes less clear, as these sclerites lose their sharpness of outline. The helomyzids appear to follow their own path of specialization within the family, but the helomyzid *Anorostoma* furnishes some excellent clues for interpreting the modifications occurring in the next stage of the series represented by the anthomyid *Hylemyia*.

In the helomyzid *Anorostoma* (Fig. 13, C), the lateroverted seventh sternite *7s* drags along the asymmetrical sixth sternite *6s* by one corner, as it becomes adherent to the inverted eighth sternite *8s* (from which it is still demarked by a suture), and in the anthomyid *Hylemyia* (Fig. 13, D), the seventh sternite *7s*, to which the sixth sternite *6s* tends to become attached by one corner, becomes still more closely adherent to the inverted eighth sternite *8s* (from which it is still demarked by an incomplete suture). Although the sinistral spiracle of the seventh segment enters the upper corner of the seventh sternite *7s* behind it, in *Hylemyia* (Fig. 13, D), it does not do so in *Anorostoma* (Fig. 13, C), in which the seventh spiracle is not borne in a tergite, so that the presence of the sinistral seventh spiracle in the upper corner of the seventh sternite *7s* of *Hylemyia* (Fig. 13, D) cannot be cited as positive proof that the seventh tergite forms a part of the sclerite labelled *7s* in Fig. 13, D, of *Hylemyia*, although from other evidence this may be the case (e. g., the presence of the sinistral seventh spiracle in the vestigial tergite *7t* of the insects shown in Fig. 14, A and C).

The next stage in the series is illustrated by the calliphorid *Phormia regina*, shown in Fig. 13, E, in which the suture between the vestigial seventh sternite *7s* and the inverted eighth sternite *8s* becomes obliterated, although its former course is indicated by a faintly impressed line indicated by a dotted line in Fig. 13, E. The union of the seventh sternite with the inverted eighth sternite to form a synsternite is now complete, but the fact that the sinistral spiracle of the seventh segment remains close to the anterior border of the synsternite indicates that the seventh sternite does not contribute much to its area.

The asymmetrical sixth sternite *6s* of Fig. 13, E, (which borders the genital pouch, or cubiculum, *phc* of Fig. 14, F, into which the aedeagus *pha* is thrust in repose) now becomes more closely associated with the synsternite *7s+8s* than with its own tergite *6t*, and in fact the sixth sternite *6s* is interpreted as the sternite of the eighth segment by Snodgrass (1935) who regards the synsternite as the eighth tergite in the closely related fly *Pollenia rudis*. If, however, we trace the modifications of the sixth sternite *6s* of *Phormia regina* (Fig. 13, E) back through the successively less modified stages in the series shown in Fig. 13, D, C and B, to a similarly modified syrphid such as *Paragus*, shown in Fig. 13, A, and then trace the parts on back to a less modified syrphid such as *Sericomyia* shown in Fig. 12, F, in which the sixth sternite *6s* is clearly recognizable as such, and retains its normal relations to the sinistral sixth spiracle and the sixth tergite *6t* above it, the conclusion that the sclerite labelled *6s*

is actually the sixth sternite throughout the series here figured, seems inevitable: and instances such as this, demonstrate the superiority of the method of comparative morphology for solving such problems, although this method is little esteemed by recent investigators!

The sinistral spiracle of the seventh segment is borne close to the anterior border of the synsternite $7s + 8s$ in the male housefly (Fig. 13, F), indicating that the seventh sternite, with which the spiracle is usually associated, plays but a small part in the formation of the synsternite. The surstyli, *ss*, like the cerci, *ce*, are broad and flat; and in the housefly they become approximated ventrally to form a divided plate-like structure which was mistaken for the divided sternite of the genital segment by Berlese (1909) and Hewitt (1914), but a comparison of the parts with those of the other insects in the series here described, readily reveals the true nature of these structures.

The sclerites in the metopiid (sarcophagid) fly *Sarcophaga faculata* shown in Fig. 14, B, resemble those of the calliphorid *Phormia regina* shown in Fig. 13, E, but the sixth tergite has been almost obliterated in *Sarcophaga* (Fig. 14, B), and the synsternite $7s + 8s$ is greatly elongated. The sinistral spiracle of the seventh segment is situated near the middle of the synsternite, which may indicate that a relatively large portion of the synsternite is formed by the seventh sternite.

In the cordylurid *Parallelomma* shown in Fig. 14, G, the synsternite $7s + 8s$ is greatly developed, and the sinistral spiracle of the seventh segment is situated far back in the synsternite. The sixth tergite *6t* is very large in *Parallelomma*, unlike the insects described above, in which the sixth tergite tends to become reduced or atrophied. The copulatory lobes of the fifth sternite *pgl* are greatly developed in *Parallelomma*, and the surstyli *ss* are also greatly developed in this insect.

The sclerites of other male Cyclorrhapha may be readily compared with some of the various types here described, particularly with the common fly *Phormia regina* (Fig. 13, E, Fig. 9a, A, etc.), which is a rather typical cyclorrhaphan, intermediate between the lower and the more highly specialized forms, and therefore well suited to serve as the basis for comparison with the higher and lower representatives of the group. The interpretations and terminology suggested by other investigators may also be taken up at this point, indicating those which seem to be the most acceptable, and giving the reasons for discarding those which are less so.

Berlese (1909) considers that the parts revolve in a counterclockwise direction (instead of in a clockwise direction) in the postabdomen of the Syrphidae, and consequently interprets the displaced sternites as "tergites" in his figures of *Eristalis*, etc. Metcalf (1921), on the other hand, rightly concludes that the parts revolve in a clockwise direction in the Syrphidae, and correctly identifies the displaced sternites, with the exception o fthe inverted eighth sternite, which he designates as an "urite" or complete segment. Unfortunately, however, Metcalf accepts Berlese's suggestion that the basal segments

of the abdomen merge with the metathorax in the Diptera, and consequently gives a higher number to each of the segments than it should have, which makes it very difficult to understand his statements concerning the nature of the individual segments in the Syrphidae, in his extremely important paper on the syrphid terminalia.

Balfour-Browne (1932) reverts to Berlese's old view that the parts revolve in a counter-clockwise direction in the Syrphidae, and consequently interprets the displaced sternites as "tergites" in his figures of the postabdomen of *Eristalis*. Balfour-Browne likewise follows Berlese in giving a higher number to each of the segments than it should have, which makes it very difficult to follow his statements concerning the nature of the individual segments of the postabdomen of the Diptera figured by him, but if the segments are given their correct numbers in his figures of the postabdomen of *Eristalis* and *Calliphora*, it is apparent that in deriving the calliphorid type of postabdomen from that of the syrphids Balfour-Browne concludes that the eighth and ninth segments of the syrphids unite to form the sclerite here interpreted as the ninth segment in a muscoid fly of the *Phormia* type, instead of considering that the seventh and eighth segments of the Syrphidae unite (as they do in *Paragus*, etc.) to form the pregenital composite sclerite (synsternite) in front of the ninth segment of the calliphorid flies.

Balfour-Browne (1932) and Snodgrass (1935) both agree in interpreting the sixth tergite, *6t*, of Fig. 10, E, and Fig. 13, E, as the "seventh" tergite in the muscoid flies, and both agree in regarding the sixth sternite, *6s*, as the "eighth sternite" in these flies, although they arrive at the same conclusions from very different lines of reasoning. Thus Balfour-Browne gives a higher number to all of the abdominal segments than they should have in the blowfly *Calliphora*, and consequently regards the true sixth tergite as the seventh, in this fly, while Snodgrass states that the true sixth abdominal segment appears to be obliterated in *Pollenia*, and consequently regards the true sixth tergite as the seventh, in this fly.

Snodgrass (1935) considers that the sixth sternite, *6s*, of Fig. 10, E, and Fig. 13, E, is the "eighth" sternite in such a calliphorid fly as *Pollenia* (see Fig. 13, E) because it is attached to the composite sclerite bearing the label $7s + 8s$ in Fig. 13, E, etc., which he interprets as the eighth tergite in *Pollenia*, while Balfour-Browne interprets the sixth sternite, *6s*, of Fig. 13, E, as the "eighth" sternite in *Calliphora* because he gives a higher number to all of the segments than they should have, in the abdomen of the Diptera in general; and neither of these investigators has suggested the possibility of an inversion of the true eighth sternite in the muscoid Diptera. Cole (1927) likewise interprets the sixth sternite, *6s*, as the "eighth" sternite in *Hylemyia* (Fig. 13, D) and considers that the inverted eighth sternite is the eighth "tergite" in such flies as *Tetanops aldrichi*, etc. Awati (1915), on the other hand, interprets the sixth sternite, *6s* of Fig. 13, E, as the "seventh" sternite in the muscoid flies, while Berlese (1909) interprets the sixth sternite, *6s*, of Fig. 13, F, as the

"ninth" sternite in the housefly. Parker (1914), Hewitt (1914), and Patton (1932) have interpreted the sixth sternite correctly in their figures of the housefly and other muscoid flies, but the interpretations of the true seventh and eighth segments given by these investigators are very different from those suggested here, and the inversion of the eighth sternite, etc., is not recognized by any of these writers.

The area labelled *7s* in Fig. 13, D, of *Hylemyia* is regarded as the seventh tergite alone by Cole (1927), who states that "the seventh sternite is missing" in *Hylemyia*, although according to the interpretation here proposed, the area labelled *7s* in Fig. 13, D, of *Hylemyia* is formed by the lateroverted seventh sternite, and only a negligible portion of the area in question is formed by the vestigial seventh tergite in *Hylemyia*.

Awati (1915), Edwards (1920), and Patton (1932) consider that the eighth abdominal segment is lost in the higher Diptera, and would consequently interpret the synsternite labelled *7s* + *8s* in the muscoid fly shown in Fig. 13, E, as the seventh "tergite", largely because this sclerite bears the spiracle of the seventh abdominal segment—although the method by which the spiracle of the seventh segment was brought into this composite plate has been accounted for in another way in the preceding discussion. Snodgrass (1935), on the other hand, evidently does not take into account the occurrence of the seventh spiracle in the synsternite in *Pollenia* (Fig. 13, E) and interprets it as the eighth "tergite" in this fly (although the eighth segment never bears a spiracle in any male Diptera) because he considers that the seventh tergite is represented by the true sixth tergite, *6t*, of Fig. 13, E, and states that the sixth segment appears to be obliterated in *Pollenia*.

The view that the composite synsternite labelled *7s* + *8s* in the fly shown in Fig. 13, E, represents the "seventh tergite" alone, apparently goes back to Lowne (1890-1895), who interprets the sclerite in question as the "seventh tergite" in the blowfly, and interprets the ninth tergite as the "eighth" in this insect. Parker (1914) likewise interprets these sclerites as the seventh and eighth tergites in the Sarcophagidae, and Hewitt (1914) does the same in the housefly, in which he considers that the surstyli, *ss*, and cerci, *ce*, of the housefly shown in Fig. 13, F, represent the divided seventh and eighth sternites in this insect. In a paper published with Carpenter in 1914, Hewitt has attempted to correct his former interpretation of the terminalia of the housefly by comparing the parts of the postabdomen with those of the warblefly, *Hypoderma*. The sclerites are very greatly modified in *Hypoderma*, however, and it would appear that Hewitt regards a plate in the terminalia of *Hypoderma* which seems to be homologous with the synsternite bearing the label *7s* + *8s* in Fig. 14, B, as an "intersegmental membrance", despite the fact that the intersegmental membrances usually do not bear setae, as this plate does in *Hypoderma*, so that Hewitt's interpretations of the terminalia of these flies evidently need further revising.

Berlese (1909) and Metcalf (1921) interpret the ninth segment,

9*t*, of Fig. 12, F, and Fig. 13, E, as the tenth segment in the Syrphidae and Muscidae, while Hewitt (1914), Parker (1914), and Lowne (1895) consider that it represents the eighth segment in the higher Diptera, but most of the recent students of the muscoid flies agree in interpreting this segment as the ninth, since it bears the male genital organ which is an "appendage" of the ninth segment in male insects in general.

Of the various interpretations of the parts of the postabdomen of the muscoid Diptera discussed above, those proposed in the fine paper by Cole (1927) are the most nearly in accord with those accepted here. The principal difference between Cole's interpretation of the segments of the postabdomen, and the interpretation suggested here, is that Cole considers that the eighth sternite of one of the muscoid flies such as *Hylemyia* shown in Fig. 13, D, is represented by the sclerite here interpreted as the sixth sternite, labelled 6*s* in Fig. 13, D, (Cole states that the eighth sternite is represented by "a narrow strip on the left side" in *Hylemyia*, and labels the sixth sternite as the "eighth" in his Fig. 213 of this insect): and Cole considers that the sclerites labelled 7*s* and 8*s* in Fig. 13, D, of *Hylemyia* represent the seventh and eighth "tergites" in this insect, instead of representing the seventh and eighth sternites, as they are here interpreted.

The terms which have been applied to the parts of the copulatory apparatus of male muscoid flies by various workers in this group are listed in the following discussion, in which the terms which appear to be the most appropriate, or those which are the most widely accepted, have been selected for describing the parts in a typical muscoid fly represented by *Phormia regina* shown in Fig. 13, E, and Fig. 10, E, etc.

The fifth sternite, or last sternite of the preabdomen of *Phormia*, is deeply cleft posteriorly to form a pair of posterior lobes labelled *pgl* in Fig. 13, E, or Fig. 10, E, etc. These lobes, or processes, are frequently used in mating, and therefore may be included among the "copulatoria" or general structures used in copulation, but they should not be included among the "terminalia", as is done by Patton (1932), since the terminalia are parts of the postabdomen lying behind the fifth, or last sternite of the preabdomen.

The lobes or processes of the fifth sternite (*pgl* of Fig. 13, E) are sometimes referred to as the pregenital lobes (or processes) by dipterists, although Patton (1932) states that the designation primary forceps (used by Hewitt, 1914, and others) is the one usually applied to them. Awati (1915) calls these lobes the accessory forceps, Parker (1914) refers to them as the lamellae, and Wesché (1906) calls them the laminae "superiores", although they are ventral in position. The designation "forceps" is not an appropriate one for the posterior lobes of the fifth sternite, since these lobes are not forcipate: and the true genital forceps are appendages of the ninth, not the fifth segment. On this account, it is preferable to refer to the structures in question simply as the posterior lobes or processes of the fifth sternite.

The posterior processes of the fifth sternite are highly modified in the Calobatidae. Thus in the calobatid *Cardiacephala* shown in Fig. 10, I, they have the form of long, slender copulatory processes, and in the calobatid *Calobata*, shown in Fig. 10, B, the processes of the fifth sternite are remarkably modified. It is also possible that the anteriorly directed sternal process of the micropezid shown in Fig. 14, A, may be a modified process of the fifth sternite, but this has not been definitely determined.

The segmental complex bearing the label $7s + 8s$ in the flies shown in Fig. 13 E, and Fig. 14, B, etc., is referred to as the first genital "segment" in the Sarcophagidae; and the ninth segment, *9t*, is called the second genital segment in the Sarcophagidae, in which group these "segments" are sometimes referred to as the anal segments, according to Parker (1914). Other dipterists apply the designations pregenital "segment" and genital segment to these structures.

The ninth abdominal segment is the true genital segment of the male, and in the lower insects it is referred to as the andrium. If the latter term is applied to the ninth segment, the preceding segmental complex may be referred to as the protandrium, although the designations pregenital "segment" and genital segment are useful designations for the structures in question, if it is borne in mind that the so-called pregenital "segment" is in reality a segmental complex made up of the united seventh and inverted eighth sternites.

Hendel (1928) states that the ninth tergite, *9t*, of Fig. 13, E, etc., is called the lamina basalis in the Schizophora. The ninth tergite is referred to as the epandrium in the lower insects, and this term might be applied to it in the higher Diptera, if it is desirable to refer to the ninth tergite by a single term in order to avoid confusion or uncertainty in counting the apparent segments of the abdomen in these insects. Patton (1932-1935) refers to the ninth tergite alone as the "ninth tergo-sternum", but this designation is very confusing to those who consider that there is a distinct sternum in the ninth segment (*9s* of Fig. 13, E, etc.), which does not unite with the ninth tergite.

According to Snodgrass (1935), the Y-shaped sclerite bearing the label *9s* in Fig. 13, E, or in Fig. 14, E, etc., represents the ninth, or genital sternite in the muscoid fly *Pollenia rudis*; and Parker (1914) refers to this sclerite as the genital sternum (which he states is equivalent to the "progenital sternum" of Lowne, 1895), or sternum of the genital segment, which, however, is interpreted as the eighth, instead of the ninth segment, of the Sarcophagidae, by Parker. Other investigators have given the most diverse interpretations to this sclerite in the Cyclorrhapha. Thus Awati (1915) considers that the ninth sternite, *9s* of Fig. 10, E, or Fig. 14, E, represents the "body of the theca" (i. e., the basal region of the male genital organ) which he calls the vinculum, and maintains that the ninth sternite has dropped out in the muscoid Diptera. Edwards (1920) is inclined to accept Awati's view that the ninth sternite has dropped out in the higher Diptera, but offers the suggestion that the ninth sternite of the higher

Diptera may possibly be represented by the structure which Awati calls the "vesiculum" (a misprint for vinculum?). Edwards (1920) suggests as an alternative view, that the ninth sternite of the higher Diptera may be represented by the structures called the "edita" by Newstead (1911) in *Glossina* (i. e., the surstyli labelled *ss* in Fig. 13, E). Hewitt (1914) and Berlese (1909) also consider that the surstyli of the housefly (i. e., the structures labelled *ss* in Fig. 13, F) represent the halves of the "genital sternite", but the structures in question are appendages of the ninth tergite homologous with the surstyli of lower insects. In a footnote to page 49, Hendel (1928) makes the further suggestion that the anterior gonapophyses, *ago*, of Fig. 13, E, represent the "ninth sternite", while the posterior gonapophyses, *pgo*, may represent the "tenth sternite" in the higher Diptera.

The ninth sternite or hypandrium, labelled *9s* in Fig. 14, E, of a typical muscoid fly, is a flat Y-shaped plate embedded in the dorsal wall of the membranous genital pouch or cubiculum, *phc*, of Fig. 14, F, just in front of the base of the male genital organ labelled *pho* in Fig. 10, E, or Fig. 14, E, etc. The flat anterior portion, or "stem" of the Y-shaped plate, projects forward and upward from the lower angles of the ninth tergite, *9t*; and a plicate fold at its anterior end projects internally to form an apodeme-like projection labelled *ha* in Fig. 10, E, Fig. 14, E, or Fig. 14, F, Fig. 9a, A, etc., which may be called the hypandrial apodeme.

The posterior arms of the Y-shaped ninth sternite, *9s*, extend backward on each side of the base of the male genital organ, *pho*, of Fig. 14, E, or Fig. 10, E, etc., and are connected with the bases of the surstyli, *ss*, by connecting rods in the form of bacilliform sclerites, *bcs*, lying just below the lateral margins of the ninth tergite, *9t*. These connecting rods probably aid in flexing the surstyli, *ss*, of Fig. 14, E, (and the cerci, *ce*, which are closely associated with the surstyli) when the Y-shaped sclerite, *9s*, is drawn forward. Patton (1932-1935) refers to these connecting rods as the basal segments of the "coxites" (i. e., the basal segments of the surstyli, *ss*, which he regards as the homologues of the "coxites" or basimeres), but the connecting rods are probably merely secondarily-developed sclerites which do not occur in all of the higher Diptera. It is possible that the vestigial sclerites which Patton (1934) regards as the "sclerotized spiracles" of the eighth segment in the Sarcophagidae may represent the remains of such connecting rods in these insects. At any rate, they do not represent the "sclerotized spiracles" of the eighth segment, since the eighth abdominal spiracles are always absent in male Diptera.

On each side of the base of the male genital organ, *pha*, of such muscoid flies as *Phormia* (Fig. 13, E), *Hylemyia* (Fig. 13, D), etc., is a pair of sclerites, *ago* and *pgo*, called the anterior and posterior gonapophyses by Lowne (1895) in the male blowfly. The gonapophyses are also referred to as the parameres by Bruel (1897) and Patton (1932), and by Hendel (1928), who refers to the anterior gonapophyses as the distal gonapophyses (or parameres) and designates the

posterior gonapophyses as the proximal gonapophyses (or parameres). Parker (1914) refers to the gonapophyses as the anterior and posterior claspers. Huckett (1924) designates the gonapophyses as the internal lobes in the Anthomyidae (a term taken from Metcalf's terminology for the parts in male syrphids) and designates the anterior gonapophyses as the cephalic or outer pair, and refers to the posterior gonapophyses as the caudal or inner pair. Wesché (1906) refers to the anterior gonapophyses as the palpi genitalium, and the posterior gonapophyses as the forcipes interiores. Newstead (1911) refers to the gonapophyses as the inferior claspers, and Awati (1915) refers to them as the appendages of the vinculum.

According to Parker (1914), the anterior and posterior gonapophyses, which he calls the anterior and posterior "claspers", act upon a small plate which he calls the fulcral plate; and Patton (1932-1935) describes the structure and method of articulation of the gonapophyses (which he calls the parameres) in a number of muscoid flies.

The gonapophyses in some cases bear sensory setae, and it seems logical to suppose that such structures as these, which play an important part in the mating process, may have a sensory function (although Metcalf, 1921, considers that the cerci are the only "sensory organs" in this region of the abdomen), and in fact Wesché (1906) refers to the anterior gonapophyses as the "genital palpi", thus implying that they have a sensory function to some extent. The chief function of the gonapophyses, however, is to serve as hooked processes which fit into certain pockets of the female postabdomen during the mating process.

Most of the recent students of the higher Diptera, such as Patton (1932), Hendel (1928), etc., refer to the gonapophyses of the higher Diptera as parameres, although they do not homologize the gonapophyses of the higher Diptera with the genital forceps, or true parameres, of the lower Diptera, since they homologize the surstyli, *ss*, with the genital forceps of lower Diptera, instead! Lowne (1895) likewise states that the anterior gonapophyses of the blowfly are undoubtedly homologous with the claspers of the genital forceps of male Hymenoptera, but since the Stratiomyidae, Therevidae and other Diptera which have well developed genital forceps, or parameres, may also have distinct gonapophyses (see *pgo* of Fig. 12, C) it is hardly justifiable to homologize the gonapophyses of the higher Diptera with the genital forceps or parameres of other insects, and in fact the gonapophyses of male Cyclorrhapha may be peculiar to these insects.

The male genital organ of the Cyclorrhapha or the external sclerotized portion of the genital tube of these insects, is variously referred to as the aedeagus (Foudras, 1859), phallosome (Christophers, 1922), mesosome (Waterson, 1914), and adminiculum (Westhof, 1882); and the designation intromittent organ or penis was frequently applied to it by the earlier dipterists.

Most of the recent writers are inclined to restrict the designation penis to the membranous, usually eversible portion, through which the seminal fluid is discharged, and apply the designation

aedeagus to the rigid portion which serves to guide the membranous penis, which is exserted by blood pressure. The designation intromittent organ might be applied to the entire organ, although some writers are inclined to restrict this designation to the penis alone. The terms phallosome* and aedeagus are the ones most frequently applied to the external sclerotized portion of the genital tube by recent dipterists, and Westhof's term adminiculum is seldom employed by them.

In a typical muscoid fly such as *Phormia regina* shown in Fig. 10, E, and Fig. 14, E, the aedeagus is composed of a distal portion, or phallus, *pha*, and a basal portion or phallophore, *pho*, which bears the phallus. Huckett (1924), who adopts the terminology proposed by Metcalf (1921) for the Syrphidae, calls the phallophore and phallus the "chitinous box" and "ejaculatory process" in the Anthomyidae, although this application of the designation "chitinous box" is not exactly the same as that employed by Metcalf. Carpenter and Hewitt (1914) apply the designations juxta and theca to the phallophore or basal portion of the aedeagus in *Hypoderma*, while Newstead (1911) refers to the part in question as the juxta or penis sheath in *Glossina*. Hendel (1928) refers to the phallophore and phallus as the theca and phallus, apparently adopting the designation "theca" from Wesché (1906), who first applied it to the basal region here designated as the phallophore.

It is inadvisable to apply the designation "theca" to the basal region of the aedeagus labelled *pho* in Fig. 10, E, Fig. 14, E, etc., since the term theca is also used to designate a wide range of structures in the Diptera, and in other insects as well. Thus Hendel (1928) applies the designation "theca" to the hyoid sclerite in the labium of the Diptera, and also applies the same term to the basal region of the aedeagus as well in these insects, while most of the recent students of the Diptera apply the designation theca to the sclerite of the labium here designated as the prementum. The coccidologists, on the other hand, apply the designation "theca" to the crumena of the coccids, and other entomologists refer to the outer covering of pupal insects as the "theca", and there is such great confusion in the application of this term that it is preferable to drop it altogether.

Lowne (1893-1895) refers to the phallic spine labelled *goa* in Fig. 13, E, and Fig. 10, E, etc., as the epiphallus, and this term is as appropriate as any that have been applied to it. Hewitt (1914) calls it the superior apophysis in the housefly, while Wesché (1906) calls it the spinus titillatorius, and Huckett (1924) refers to a similar structure in male anthomyids as the ejaculatory hood, although the latter designation is not used in exactly the same sense as that employed by Metcalf (1921), who introduced this term in his descriptions of the parts in male Syrphidae.

Lowne (1895) applies the designation paraphallus to the parts

* Students of the Tipulidae restrict the designation phallosome to the structure at the base of the aedeagus *ae* of the tipulid shown in Fig. 7, J, and this usage has much to recommend it.

of the phallus labelled *pap* in Fig. 10, E, and applies the term hypophallus to the structure labelled *hph* in Fig. 10, E: and these terms are the ones usually accepted for the structures in question by the students of the higher Diptera. Berlese (1909), however, employs these terms in a different sense from that proposed by Lowne, since Berlese applies these designations to the channels of the phallophore region which he considers are parts of the eighth and ninth segments combined, although the phallophore is a structure belonging entirely to the ninth segment. Newstead (1911) applies the designation harpes to the parts of the hypophallus, etc., but the term harpes has been applied to such a varied assortment of structures in the neighborhood of the aedeagus that it is almost impossible to determine what is meant when this term is used, and if the term harpes is used at all, it is preferable to restrict it to the distal segments of the genital forceps.

Carpenter and Hewitt (1914) refer to the membranous distal portion of the aedeagus as the glans penis; and the term acrophallus has been applied to the region of the phallus distal to the paraphalli, which is sometimes differentiated in the Calliphoridae and related muscoid flies.

The phallus becomes greatly developed in some of the higher Diptera, and the phallus of *Palloptera terminalis* shown in Fig. 244, p. 493, of the paper by Cole (1927) is modified in a remarkable manner, while the aedeagus of the otitid fly shown in Fig. 10, J, takes on the form of a long, flat, spirally coiled ribbon.

The large apodeme, *aad* of Fig. 10, E, Fig. 14, E and F, and Fig. 9a, A, etc., at the base of the aedeagus, may be referred to as the phallic, or aedeagal apodeme. Patton (1932) designates it as the shaft or apodeme of the phallosome, while Snodgrass (1935) calls it the basal apodeme.* Huckett (1924) adopts Metcalf's designation sustentacular apodeme for the aedeagal apodeme in the Anthomyidae, and Hewitt (1914) refers to it as the inferior apophysis in the housefly. Wesché (1906) calls the aedeagal apodeme the great apodeme, and states that the parts are paired in *Gynoplistia*, *Bibio* and *Tabanus*, and are partially fused in *Glossina* and *Sepsis*, while they are fused or united in the median line in *Calliphora* according to Lowne (1895), who calls them the great apodemes.

A diverticulum, or sac of the ejaculatory duct, *ed*, forms the ejaculator or ejaculatory sac, bulb or syringe, labelled *sac* in Fig. 9a, A, of the parts of *Phormia regina*. This sac, called the sperm pump by Patton (1932), was first described by Wesché (1906), who applied the designation ejaculatory apodeme to the flat central sclerite which arises from one side of the cuticular lining of the duct, and supports the muscular sheath of the sac. This sclerite (called the sperm pump sclerite by Patton, 1932) is drawn into the sac by the action of the muscles mentioned above, and acts as a piston, or the plunger of a syringe, to force out the seminal fluid from the sac

* The best illustrations of the sclerites and their muscles are given in Fig. 310, page 606, by Snodgrass (1935), and by Graham-Smith (1928).

into the common ejaculatory duct. In all of the Cyclorrhapha examined by the writer (including a series from the Syrphidae to the higher muscoid types) this common efferent duct, *ed*, loops up from the insect's left side over the top of the hind gut (see Fig. 14, H, and Fig. 9a, A) to the insect's right side before it discharges ventrally through the aedeagus, and this fact is "proof positive" that the ninth segment undergoes a circumversion (while the eighth sternite becomes inverted) in a clockwise direction in these flies, as was mentioned before.

The surstyli or edita, *ss*, of Fig. 13, E, of *Pollenia*, or Fig. 13, D, of *Hylemyia*, etc., are "appendages" of the ninth tergite which serve as accessory claspers in mating. They are well developed in such lower Diptera as the ptychopterid *Bittacomorpha* shown in Fig. 10, K, and are quite long in certain anthomyids such as the one shown in Fig. 7, K, while in the housefly shown in Fig. 10, L, they are broad and stout, and have the appearance of a divided sternite of the genital segment for which they were mistaken by Berlese (1909) and Hewitt (1914).

The surstyli, *ss*, of Fig. 13, E, and Fig. 13, D, are designated as the styli of the "gonopods" (i. e., the distimeres of the genital forceps) by Hendel (1928) in his diagram of the terminalia of a typical schizophoran, and Awati (1915) also considers that the surstyli of the Cyclorrhapha represent the so-called "genital styles" (or distal segments of the genital forceps) of the lower Diptera, in which, according to Awati, the basal segments of the forceps (*cxi* of Fig. 12, G) represent the divided "ninth sternite". Metcalf (1921) likewise refers to the surstyli as the "styli" in the Syrphidae, and Berlese (1909) calls them the mesostyli in the syrphids. Huckett (1924) homologizes the surstyli with the distimeres or dististyli (distal segments of the genital forceps) in the anthomyids, and Cole (1927) considers that the surstyli represent the distal segments of the genital forceps in some cases, and homologizes them with the distimeres, or so-called harpes, harpagones, etc., of lower Diptera. Patton (1932-1935), on the other hand, homologizes the surstyli with the "coxites", or basimeres of the genital forceps of the lower Diptera, and all of these investigators regard the surstyli as parts of the genital forceps of the lower Diptera, although the surstyli are appendages of the ninth tergite, while the genital forceps of the lower Diptera are sternal structures homologous with the parameres of the Hymenoptera and Coleoptera.

Balfour-Browne (1932) considers that the surstyli, *ss*, and cerci, *ce*, of Fig. 13, E, are parts of the same structure in the blowfly, and Lowne (1895) refers to the cerci and surstyli as the internal and external valves of the "progenital" segment in the blowfly. Wesché (1906) refers to the surstyli as the forcipes inferiores in the higher Diptera, and Newstead (1911) calls them the edita in *Glossina*. Wesché (1906) states that the surstyli have been called the zygapophyses and claspers by some investigators, and Hendel (1928) states that they are called the paralobes by Pandellé, and the valvulae laterales by Schraeder.

The non-segmental, anus-bearing telson, the cercus-bearing eleventh abdominal segment, and the tenth segment tend to unite to form a terminal, anus-bearing segmental complex in the lower insects, and there is every reason to suppose that the so-called "anal segment" of the Diptera was formed in the same way, unless the eleventh segment (or the tenth) merely dropped out, instead of uniting with the others, which is not very probable. If the appendages labelled *ce* in Fig. 13, E, etc., are really the cerci, or appendages of the eleventh segment, then the cercus-bearing eleventh segment must have entered into the composition of the "anal segment" in the Diptera, although Edwards (1920) and others who refer to the "anal segment" in the Diptera, usually interpret it as the tenth segment alone, even when they accept the view that the appendages it bears are true cerci!

It is inadvisable to refer to the proctiger, *pgr*, of Fig. 13, E, etc., as the "anal segment" in the Diptera, since it is not a single segment, but is apparently a segmental complex bearing the anal opening; and the telson, or true anus-bearing terminal region, is not a segment, but is merely a terminal region which does not contain caelom sacs in the embryonic stages of arthropods in general (i. e., it corresponds to the telson of the Crustacea, etc.). Furthermore, the designation "anal segments" is sometimes applied to the ninth segment and the preceding segmental complex in male sarcophagids, etc., and in such cases it would be confusing to refer to the anus-bearing region as the "anal segment", so that it is preferable to refer to the anus-bearing region, *pgr*, as the proctiger in the higher Diptera, as is done in the lower forms.

The cerci, *ce*, of Fig. 13, D, E, and F, or Fig. 7, K, etc., of the males of the higher Diptera, are homologous with the structures called cerci in male mosquitoes; and Christophers (1923) has shown that at least the distal portions of these structures of the males correspond to the cerci of female mosquitoes and other Nematocera. These in turn appear to be homologous with the structures which most entomologists agree are true cerci in female Mecoptera. It therefore seems probable that at least the distal portions of the structures labelled *ce* in the figures of the males of the higher Diptera are formed by the cerci, although the parapodial plates (or paraprocts) may possibly contribute to the formation of the basal regions of these structures, and in fact Wesché (1906) suggests that these processes of the higher Diptera are homologous with the parapodial plates (paraprocts) of the roach *Periplaneta*, and Cole (1927) also homologizes them with the paraprocts of lower insects. In the present discussion, however, these structures will be referred to simply as the cerci in the males of the higher Diptera.

Berlese (1909) was the first to homologize these structures in the Diptera with the true cerci, or appendages of the eleventh segment, and calls them acrocerci in male syrphids (*ce* of Fig. 12, F), although he calls the same structures the "mesocerci" in the male housefly (*ce* of Fig. 13, F) and considers that they are appendages of the tenth segment in the latter insect. Awati (1915), Metcalf (1921), Hendel

(1928), Patton (1932), and other recent dipterists agree in interpreting these structures as the cerci in the males of the higher Diptera, but Snodgrass (1935) refers to them as "the lateral lobes of the membranous tenth segment" in his figures of a male of *Pollenia rudis* (Fig. 14, F), and apparently thinks that they have no relationship to the structures which he calls the cerci in female Mecoptera.

It is unfortunate that many recent dipterists have adopted Awati's method of referring to the cerci as "anal cerci" in the higher Diptera, which is either superfluous or misleading. There are no anterior cerci to be confused with the "anal" ones, if the qualifying adjective "anal" signifies structures which are posterior in position, as contrasted with those which are anterior in position, so that in this case the adjective "anal" is superfluous. On the other hand, if the adjective "anal" implies that the cerci belong to an "anal segment", this is very misleading, since the true cerci are appendages of the eleventh segment, whereas the anus belongs to the non-segmental telson situated behind the cercus-bearing eleventh segment in embryo insects, etc., and the cerci therefore do not belong to an "anal segment" and should not be referred to as "anal cerci" in this connection.

The cerci, *ce*, and surstyli, *ss*, of Fig. 13, D and E, etc., of the males of the higher Diptera usually lie close together and project ventro-cephalad beneath the delicate genital structures to protect them, while the processes of the fifth sternite, *pgl*, frequently extend backward below them, up to the bases of the surstyli, *ss*, leaving the sensitive areas of the cerci, and the anal opening, exposed. The cerci of these Diptera bear sensory setae, and Metcalf (1921) considers that the cerci are the only sensory structures in this region of the abdomen.

In the male housefly shown in Fig. 10, L, and Fig. 13, F, the cerci, *ce*, are broad flattened plates which become approximated mesally, and were mistaken for the divided sternite of the genital segment by Berlese (1909), who considered it to be the tenth segment, and by Hewitt (1914), who considered it to be the eighth segment. In the warble fly, *Hypoderma*, however, Hewitt considers that the cerci represent the divided tergite of the tenth segment, and Edwards (1920) would apparently support this view, since he states that in male Mycetophilidae, Bibionidae, etc., the tenth tergite is divided into two "hairy lamellae resembling the cerci of the female." Edwards also describes a supposed sternite of the tenth segment in males of these insects, but it is rather doubtful that a true tenth sternite is present in male Diptera, and it may be that the paraprocts or parapodial plates, representing the divided eleventh sternite (according to the embryologists), may persist in some of these insects to form the divided ventral plate found in the proctiger of certain Diptera, but this has not been definitely proven to be the case. At any rate, the cerci do not represent the divided tergite of the tenth, or any other segment, since true cerci are the modified limbs of the eleventh segment; and if the structures called cerci in male Cyclorrhapha are true cerci, they rep-

resent the modified limbs of the eleventh segment which enters into the composition of the proctiger. The cerci tend to unite mesally in certain of the higher Diptera, but frequently remain distinct in the Cyclorrhapha, and are usually better developed in the males than in the females of these Diptera, being extremely long and well developed in the males of such Cyclorrhapha as the one shown in Fig. 7, K.

The cerci, *ce*, may serve as copulatory prongs in male Sarcophagidae (Fig. 14, B), in which group they are referred to as the "forceps" by Parker (1914), Aldrich (1916), and other students of these Diptera. Metcalf (1921) lists the designation lamellae of Lundbeck, forcipes superiores of Wesché, 1906, (substituted by him for Lowne's designation valvulae internae), and acrocerci of Berlese (1909), as some of the terms applied to the cerci by other dipterists, and Newstead's designation superior claspers for the parts in *Glossina* was evidently suggested by Wesché's designation "forcipes superiores", cited in Metcalf's list. Hendel (1928) adds the designations valvulae mediales, mesolobes, etc., to the list of terms applied to the cerci, and Patton (1932) remarks that a "host of names" have been applied to these structures, adding the designations lamina genitale, mesocerci, etc., to those mentioned above.

The terminology and interpretations adopted in the foregoing discussion are those which have seemed to be most nearly in accord with general morphological usage, and it is to be hoped that this discussion may be of some aid in attempting to establish a uniform terminology for the external structures of the Diptera in general, which must be undertaken unless the present confusion in the terminology applied to the parts of the Diptera is to continue indefinitely. The terminologies and interpretations proposed in all of the more important papers dealing with the subject have also been discussed at length, in order to make it easier to refer to the original sources, in attempting to decide which interpretations are more nearly correct, or are more in harmony with general morphological usage. The appended bibliography has also been made as complete as possible, to the end of the year 1935 (at which time the original manuscript for this chapter was first completed) to aid in referring to the publications which contain figures and descriptions of the external structures of the Diptera.

It has naturally been impossible to include descriptions of all of the structural modifications occurring in such a large group as the Diptera, in the foregoing discussion, but an effort has been made to include descriptions of the principal basic or fundamental types in this discussion, so that the parts of the commoner forms, at least, may be readily referred to some one of these types for comparison, to determine the homologies of the structures occurring in them. In addition, descriptions of the most striking modificational extremes occurring in the Diptera have also been included, in order to indicate the range of structural variations occurring in the Diptera in gen-

eral; and by thus making this discussion of a broader and more inclusive character, it is to be hoped that it may be of more value than would be the case if it had been restricted to a description of the external morphology of the Diptera of the Connecticut region alone.

Phylogenetic Conclusions

The tentative suggestions concerning the lines of descent and the interrelations of the principal subdivisions of the order Diptera, offered in the following discussion, are based upon a comparative study of such features as the thoracic sclerites, male terminalia, etc., and are made in the hope that in the happier days to come, when the warring world returns once more to the more profitable pursuit of scientific progress, the taxonomists may be induced to attack these problems more intensively than has been the case in the past.

The ancestors of the Diptera were very closely related to the triassic fossil *Aristopsyche superba* Tillyard, and other so-called "Paratrichoptera", which apparently represent merely a suborder of the Mecoptera; and present day Mecoptera such as *Nannochorista*, *Bittacus*, etc., are strikingly like the ancestors of the Diptera in practically all of their morphological details.

The nematocerous families Tanyderidae and Psychodidae (of the subfamily Bruchomyinae), together with the Trichoceratidae, or "Petauristidae" as they are now called,* and the Tipulidae, are the nearest living representatives of the first Diptera to be evolved; and they represent the principal centers about which the rest of the Nematocera tend to group themselves.

The families clustering about the Psychodidae may be grouped in the section *Psychodomorpha*, which contains three principal superfamilies. The first of these superfamilies, the Psychodoidea, contains the families Psychodidae, Tanyderidae and Ptychopteridae or "Liriopidae". The second superfamily, the Culicidoidea, contains the families Dixidae, Culicidae, Nymphomyiidae, Chironomidae or "Tendipedidae", Ceratopogonidae or "Heleidae", Orphnephilidae or "Thaumaleidae", Simuliidae or "Melusinidae", etc. The third superfamily, the Blepharoceratoidea, which includes the Blepharoceratidae (with *Edwardsina* as its most primitive representative) and possibly the Deuterophlebiidae also (although this family may prove to be more closely related to the members of the second superfamily mentioned above), occupies an isolated position in the section Psychodomorpha, and its closest affinities have not as yet been definitely determined.

The Tipulidae are related to both the psychodoid and the anisopodoid or "phryneoid" groups of Nematocera (particularly to the Tanyderidae and Ptychopteridae, the bruchomyine Psychodidae, and the Trichoceratidae), but their line of development is on a side branch

* The less familiar family names substituted by certain modern Dipterists for the better known older names usually applied to the families of the Diptera, have been indicated in quotation marks, since they are as yet unfamiliar to most of us despite the fact that they may possibly eventually supercede the older names.

ending blindly (instead of leading to any other nematocerous families), and on this account the Tipulidae are of little phylogenetic interest. The families into which the Tipulidae (in the broad sense) are sometimes subdivided, together with such fossil forms as the "Architipulidae", etc., constitute the Tipuloidea in the restricted sense; and these might be regarded as constituting a separate section, the *Tipulomorpha*, equivalent to the other sections of the Nematocera.

The families clustering about the Anisopodidae or "Phryneidae" as a center may be grouped in the section *Phryneomorpha*, which contains three principal superfamilies. The first superfamily, the Phryneoidea, contains the families Trichoceratidae or "Petauristidae", the Anisopodidae or "Phryneidae", the Mycetobiidae, and the Pachyneuridae (also related to the Bibionoidea). The second superfamily, the Fungivoroidea, includes the Mycetophilidae or "Fungivoridae" (in the broad sense—i. e., including the so-called Sciaridae, Bolitophilidae, etc.) and the Cecidomyidae or "Itonididae". The third superfamily, the Bibionoidea, includes the Bibionidae (with *Plecia* as its most primitive representative), the Scatopsidae and the Hesperinidae (also related to the Pachyneuridae), etc.

The Anisopodidae or "Phryneidae" are of the greatest phylogenetic importance since they serve to connect the Trichoceratidae or "Petauristidae", at the base of the main stem of dipteran evolution, with the Fungivoroidea; and they also serve to connect the Trichoceratidae with the Bibionoidea, which approach the Brachycera in some respects. The chief importance of the Anisopodidae, however, lies in the fact that they appear to lead more or less directly from the Trichoceratidae or "Petauristidae" at the base of the nematoceran stem, to the Rhagionidae (Leptidae) and Therevidae at the base of the brachyceran stem, which in turn leads to the Cyclorrhapha. All of these forms tend to retain the ocelli throughout the series leading from the primitive trichocerativ stem forms on up to and including the Cyclorrhapha, despite the fact that even such closely related and primitive Nematocera as the Tipulidae, etc., tend to lose the ocelli, so that the retention of the ocelli in this evolutionary series must be regarded as a feature of considerable phylogenetic importance.

The families of orthorrhaphous Brachycera appear to cluster about two principal centers represented by the Leptidae or "Rhagionidae" and the Therevidae; and these Brachycera may be grouped into two principal sections. One section, the *Rhagiomorpha*, centering about the Leptidae or "Rhagionidae", includes three superfamilies. The first superfamily, the Rhagionoidea, includes the Rhachiceratidae, the Leptidae or "Rhagionidae", and the Hilarimorphidae (although Hilarimorpha may belong with the Bombyliidae). The second superfamily, the Tabanoidea (in the restricted sense), includes the Pantophthalmidae or "Acanthomeridae", and the Tabanidae. The third superfamily, the Stratiomyoidea, includes the Xylophagidae or "Erinnidae", the Xylomyiidae and the Stratiomyidae, etc. (although the Xylophagidae possibly belong in the Rhagionoidea, as primitive rhagionid-like forms).

A second section, the *Therevomorpha*, centering about the Therevidae at the base of the stem, includes four principal superfamilies (and possibly a fifth, whose closest affinites are uncertain). The first of these superfamilies, the Therevoidea, includes the Therevidae and the Scenopinidae or "Omphralidae". The second superfamily, the Asiloidea (in the restricted sense), includes the Mydaidae, the Apioceratidae and the Asilidae. The third superfamily, the Empididoidea, includes the Empididae and the Dolichopodidae. The fourth superfamily, the Bombyloidea (in the restricted sense), includes the Nemistrinidae, the Bombyliidae and the Cyrtidae or "Acroceratidae", with the Bombyliidae as the forms leading to the pipunculid-syrphid group at the base of the cyclorrhaphan stem. A fifth superfamily, the Phoroidea, includes the Phoridae (in the broad sense—i. e., including the Thaumatoxenidae, etc.) and the Lonchopteridae or "Musidoridae", although the latter family is not very closely related to the Phoridae, and may belong elsewhere. The exact location of the Phoroidea in the phylogenetic scheme is not clear, and the group may belong within the next subclass. At any rate it represents an isolated border-line group, of little phylogenetic interest since it does not appear to lead to any of the other groups next to be considered.

The cyclorrhaphous Brachycera, or Cyclorrhapha, may be divided into the more familiar groups Acalypteratae and Calypteratae, merely for the sake of convenience, although the presence (or absence) of the calypteres in the members of these groups is not a decisive feature; and the designation "Muscoidea" is here applied in a much more restricted sense than that in which it is sometimes employed for the cyclorrhaphous families. From the phylogenetic standpoint, the family Syrphidae (with the Pipunculidae) is the "key" group for the evolution of the Acalypteratae, and the family Anthomyidae is the "key" group for the evolution of the Calypteratae.

The families clustering about the Syrphidae as a center may be grouped in the section *Syrphomorpha*, which contains several superfamilies (some of which are not mentioned here). The first, and phylogenetically the most important of these, is the superfamily Syrphoidea, containing the Syrphidae and the Pipunculidae or "Dorilaidae", with which the somewhat more distantly related Platypezidae may also be included, although the Conopidae, which are usually placed near these families, may belong elsewhere. A second superfamily, the Ortaloidea, containing the Pyrgotidae, the Ortalidae, the Trypetidae or "Trypaneidae", the Richardiidae, and several other families, is practically a direct continuation of the syrphoid stem; and the coiled aedeagus occurring in the males of many of these forms was apparently inherited from certain pipunculid forebears, although the suppression of the sixth abdominal tergite and the linking up of the displaced sixth, seventh and eighth abdominal sternites in the males of these insects is perhaps more of a syrphid than a pipunculid feature.

It is not certain which line of development leads from the ancestral syrphoid stem group to the families at the base of the calypter-

ate stem, but the members of the superfamily Helomyzoidea, including the Opomyzidae, Clusiidae, Helomyzidae, etc., present some very interesting features suggestive of the ancestors of the lower Calypteratae, since the aedeagus of many of these forms is very suggestive of the precursor of the type of aedeagus encountered in the Anthomyidae and other forms at the base of the calypterate stem; and the Helomyzoidea retain the sixth abdominal tergite in the male, as must have been the case in the ancestors of the Calypteratae, whose primitive members have also preserved the sixth abdominal tergite in the males. On the other hand, the males of the calobatoid series (which also tend to preserve the sixth abdominal segment fairly normally developed) exhibit certain features suggestive of the precursors of the Cordyluridae (such as *Parallelomma*, etc.), which some recent dipterists consider to be primitive representatives of the calypterate stock; and it is yet uncertain which acalypterate series leads to the calypterate stem.*

The proper location of the section Hippoboscomorpha (or Pupipara) in the general phylogenetic scheme is still a matter of debate. The male genitalia of the Braulidae and Nycteribiidae are so strikingly similar that they evidently should be grouped together in the superfamily Brauloidea; but they do not resemble the Hippoboscoidea very closely in their genitalic details, and it is very difficult to determine where to place these aberrant forms.

The Calypteratae comprise the section *Muscomorpha*, which may be divided into two principal superfamilies. The first of these, the superfamily Muscoidea (in the restricted sense), contains the Anthomyidae (as the "key" group) and the Muscidae, with which the Scatophagidae might also be included; and the Glossinidae also apparently belong in this superfamily. The Cordyluridae, which are placed near the Muscidae by recent dipterists, have male terminalia of a type somewhat different from that occurring in the typical Muscoidea, and it is not clear just where the Cordyluridae belong in the phylogenetic scheme.

The second calypterate superfamily, the Tachinoidea or "Larvaevoroidea", includes the Phasiidae, the Dexiidae, the Tachinidae or "Larvaevoridae", the Oestridae, the Cuterebridae, the Sarcophagidae or "Metopiidae", and possibly the Calliphoridae (which are also very closely related to the Muscoidea). The Gastrophilidae may possibly also belong in this superfamily, although they have been placed in the acalypterate series by some dipterists.

* These and other important questions concerning the proper arrangement of the various families of acalypterate Cyclorrhapha can best be solved by studying the evolutionary trends exhibited by the male terminalia in the families in question; and it is to be hoped that these necessary studies will be made in the near future.

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Abbreviations

A . . . . anal vein
aa . . . fourth axillary sclerite (adanale)
aad . . . adeagal or phallic apodeme
aae . . . anterior anepisternum
aba . . . anterior basalare
ac . . . anteclypeus
adv . . . adventitious suture
ae . . . aedeagus
aem . . anepimeron (pteropleurite)
aes . . . anepisternum ("mesopleura")
af . . . antennifer
ago . . . anterior gonapophysis or pregonite
al . . . . anterior lateral cervicale
alb . . . apical lobe of basistyle or basimere
alo . . . axillary lobe of wing
als . . . anterior labellar sclerite
anp . . . adanal process
ant . . . antenna
ao . . . anal opening
ap . . . atrial plate
apn . . . antepronotum
ar . . . arista
arc . . . arculus
aro . . . arolium
as . . . . anepisternal suture
asc . . . anterior area of scutum
at . . . . genital atrium
atr . . . alimentary tract
av . . . anterior vertex

b . . . . basal sclerite of labella
ba . . . third axillary sclerite (basanale)
bac . . . basicosta or humeral plate
bal . . . basal lobe of basistyle or basimere
bap . . . basal plate
bc . . . basicercus
bcl . . . lower or proximal calypter
bcs . . . connecting rods or bacilliform sclerites
bcx . . . basal coxite
bf . . . . basal fold of wing
bl . . . . basilabella
bph . . . phallophore (basiphallus)
bpr . . . basiproboscis
bs . . . basisternum
bt . . . . basitarsus
bu . . . basunguis (basipulvillus)

C . . . . costal vein
c . . . . cornu or process of fulcrum
ca . . . . cardo
cb . . . intermediate plate (intergonite)
ce . . . cerci
cf . . . . coxifer
cg . . . head-bearing process (cephaliger)
cl . . . . clypeus
cla . . . claw or modified segment of dististyle or distimere
co . . . cowl
cp . . . claspette
cr . . . . maxillary apodemes (also called rostral apodemes or cryptostipes)
cs . . . coronal or sagittal suture
Cu . . . cubital vein
cx . . . coxa
cxi . . . basistyle or basimere (shaft of forcipate parameres, usually called the "coxite")

d . . . . dorsal wall of food tube
db . . . dorsal bridge
dc . . . disticercus
dcl . . . upper or distal calypter
dcx . . . disticoxa
dl . . . . distilabella
dt . . . . distitarsus

e . . . . compound eyes
ea . . . ejaculatory apodeme
ec . . . eucoxa
ed . . . ejaculatory duct
em . . . epimeron
emp . . empodium
epr . . . epiproct
es . . . . episternum
ev . . . eversible sac

f . . . . pseudotracheal fissure
fc . . . . food canal
fcl . . . frontoclypeus
fcs . . . frontoclypeal suture
fe . . . femur
fg . . . female gonopore
fp . . . frontal or pretentorial pits
fr . . . frons
fs . . . furcasternum
fu . . . fulcrum
fv . . . frontal vitta

g . . . . galea
ga . . . endomere
ge . . . gena
goa . . . spinus titillitorius (gonacanthus, or epiphallus)
gp . . . gular or postentorial pits
gpo . . . gonopore
gu . . . pseudogula
gv . . . genovertical plate

h . . . . halter
ha . . . hypandrial apodeme
he . . . head
hg . . . hypovalvae or hypogynal valves
ho . . . hyoid sclerite
hp . . . hypopharynx

hph . . . hypophallus
hpr . . . hypoproct

i . . . . interbifid space
ib . . . . interbases
ibf . . . interbasal fold
il . . . . inner lobe of basistyle or basimere
in . . . inner dististyle or distimere
inc . . . axillary incision
ins . . . insula
ipt . . . inferior pleurotergite (katatergite)
is . . . . intersegmental region
iv . . . intervenal area

kem . . katepimeron
kes . . . katepisternum (sternopleurite)

la . . . . labella or modified labial palpi
lc . . . . lateral cervicale
lg . . . ligula
li . . . . labium
loc . . . lateral occipital region
lp . . . . labellar processes
lr . . . . labrum
ls . . . . labellar sclerite
lt . . . . labial trough or gutter
lu . . . . lunule

M . . . media
m . . . . median occipital region (cerebrale)
md . . . mandible
me . . . meron
mf . . . mesofacial plate
mm . . . second axillary plate (intralare)
mn . . . mentum
mp . . . maxillary palpi
mpl . . meropleurite
mpr . . mediproboscis
mt . . . mediotergite
mtn . . metanotum

n . . . . nasus
no . . . first axillary (notale or notopterale)
npl . . . notopleural region

o . . . . ocelli
oc . . . occiput
oe . . . anterior region of foregut
of . . . occipital foramen
om . . . "oral" or subcranial margin
op . . . ocellar prominence
ot . . . . outer dististyle or distimere
ovc . . . ovicauda or oviscapt

p . . . . second segment of antenna (pedicel)
pa . . . parietal region
pad . . . phallic apodeme or aedeagal apodeme
pae . . . posterior anepisternum
pag . . . paragular sclerite
pam . . so-called "paramere" of culicidologists (endomere)
pao . . . parocciput
pap . . . paraphallus
pas . . . parascutellum
pat . . . paratergite
pc . . . precoxal bridge (precoxale)
pf . . . parafacial area
pfr . . . palpifer
pg . . . postgena
pgl . . . copulatory lobes or processes of the fifth sternite
pgn . . . paragonia (seminal vesicles?)
pgo . . . posterior gonapophysis or postgonites
pgp . . . postgenital plate
pgr . . . proctiger
pha . . phallus (portion of aedeagus)
phc . . . cubiculum, or genital pouch
pho . . phallophore or basiphallus
phs . . . structure called phallosome in male Tipulidae
pl . . . . posterior lateral cervicale
pls . . . posterior labellar sclerite
pm . . . prementum (containing labial stipites)
pn . . . pronotum
po . . . postantennal region
poa . . . postatrial sclerite
poc . . . postclypeus
pof . . . postfrons
pos . . . posterior scutum
pov . . posterior vertex
pp . . . third segment of antenna (postpedicel)
ppn . . . postpronotum
pr . . . (cerci?) part of proctiger
pra . . . preatrial sclerite
prf . . . prefrons
prs . . . presternum
ps . . . pleural suture
psc . . . prescutum
psl . . . postscutellum or postnotum
psp . . . prescutal pit (pseudosutural fovea or humeral pit)
pss . . . prescutal suture
pt . . . . pseudotracheae
ptc . . . ptilinal fissure
ptg . . . pleurotergite
ptn . . . pleurotrochantin
pv . . . pulvilli

R . . . radius
rec . . . rectum

s . . . . first segment of antenna (scape); also abdominal sternite when written after a numeral

sa . . . subalare
sac . . . ejaculatory sac or ejaculator
sas . . . subalar suture
Sc . . . subcosta
sc . . . . scutum
sd . . . salivary duct
sf . . . subalifer
sl . . . . scutellum
so . . . sense organ in maxillary palpus
sp . . . spiracle
spt . . . superior pleurotergite (anatergite)
sra . . . suralare
ss . . . . surstyli or edita
ssl . . . subscutellum
st . . . . dististyle or distimere (distal segment of the forcipate parameres, usually called the stylus)
stc . . . sustaining column
sti . . . stipes
sty . . . antennal style

t . . . . tempora or temples; also abdominal tergite when written after a numeral
tes . . . testes
tg . . . . tegula or epaulet
ti . . . . tibia
tl . . . . tergal lobes
tr . . . . trochanter
ts . . . . transcutal or transverse suture

u . . . . unguitractor
un . . . ungues or claws
ut . . . . unguitractor tendon

v . . . . ventral wall of food tube
vb . . . ventral bridge
vd . . . vas deferens

w . . . . wing

x . . . . plane connecting walls of labium

zs . . . zygostipes

FIGURE 1. ANTERIOR VIEWS OF HEAD CAPSULES.

A. *Nannochorista dipteroides* (Mecoptera).

B. *Edwardsina* (Blepharoceridae).

C. *Ornithoctona*, winged female (?) (Hippoboscidae).

D. *Oncodes gibbosus*, male (Cyrtidae), redrawn from Verrall.

E. *Acrocera globulus*, male (Cyrtidae), redrawn from Verrall.

F. *Ctenacroscelis umbrinus* (Tipulidae).

G. *Trichocera* (Trichoceridae).

H. *Boletina* (Mycetophilidae).

I. *Trisopsis oleae* (Cecidomyidae), redrawn from Kieffer.

J. *Tabanus fuscopunctatus*, female (Tabanidae).

K. *Rhingia nasica* (Syrphidae), posterior view.

L. *Cyphomyia* (Stratiomyidae).

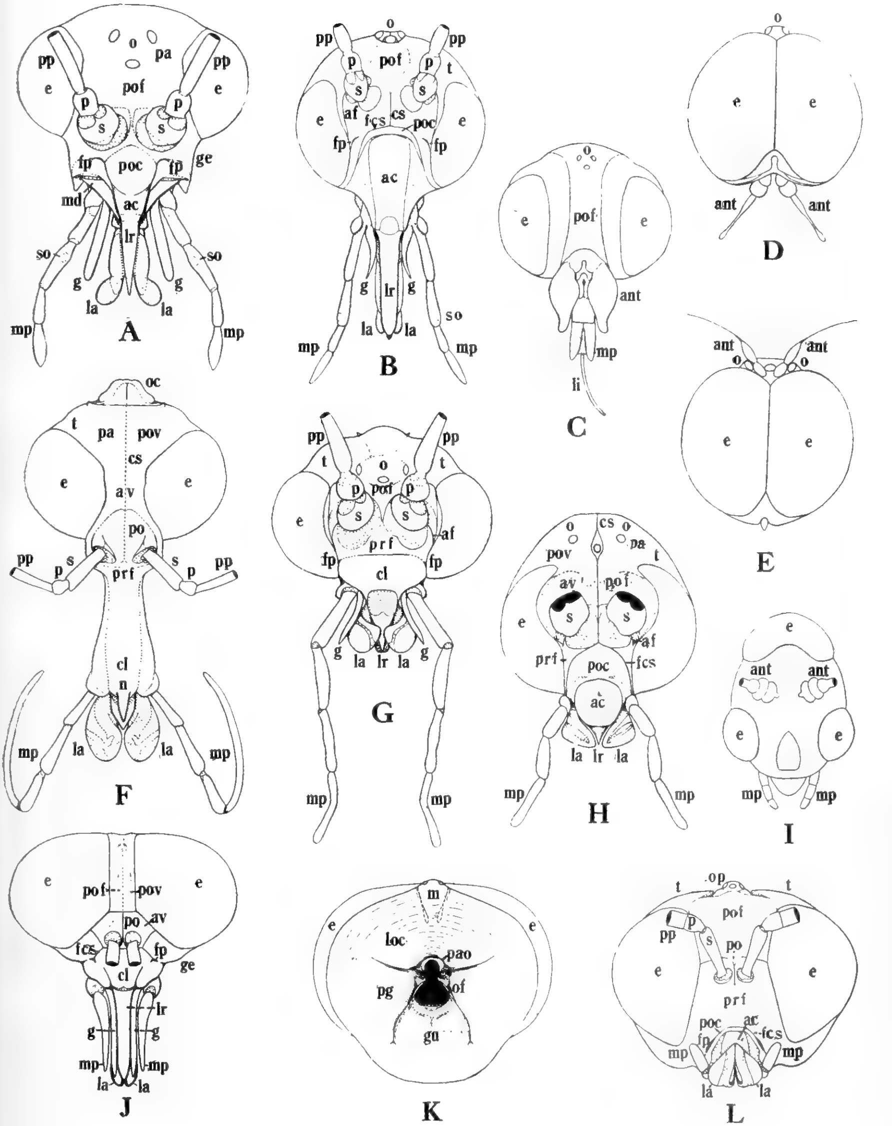
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FIGURE 2. POSTERIOR VIEWS OF MOUTH PARTS AND HEAD CAPSULES.

A. *Bittacomorpha clavipes* (Ptychopteridae).

B. *Boreus* (Mecoptera).

C. *Asyndulum montanum* (Mycetophilidae).

D. *Limonia cinctipes* (Tipulidae).

E. *Harpobittacus* (Mecoptera).

F. *Astochia* (Asilidae).

G. *Musca domestica* (Muscidae).

H. *Tanyderus forcipatus* (Tanyderidae).

I. *Nannochorista dipteroides* (Mecoptera).

J. *Edwardsina* (Blepharoceridae).

K. *Anisopus*, male (Anisopodidae).

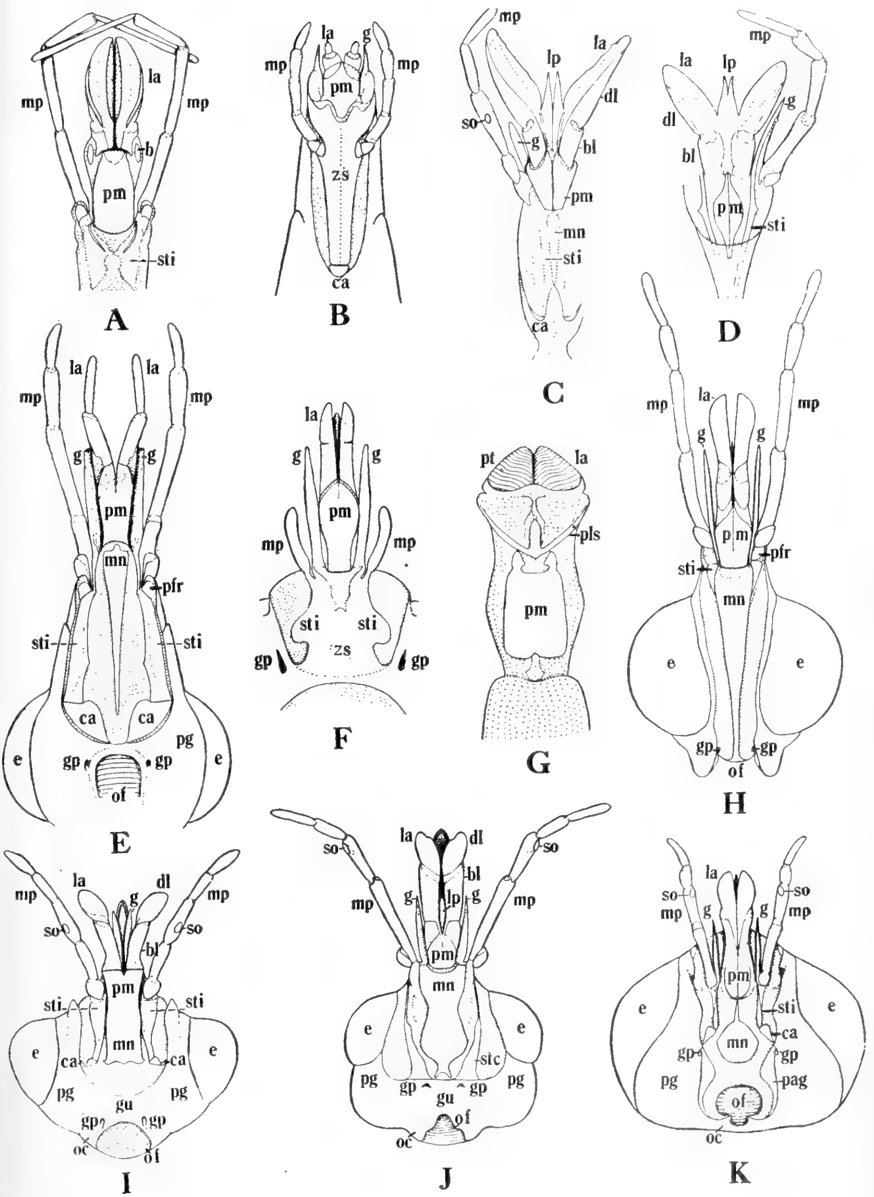
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FIGURE 3. ANTERIOR AND LATERAL VIEWS OF HEAD CAPSULES.

A. *Elephantomyia* (Tipulidae).

B. *Teleopsis*, male (Diopsidae).

C. *Lasia* (Cyrtidae).

D. *Neocurupira* (Blepharoceridae).

E. A female mosquito (based largely on *Anopheles quadrimaculatus*).

F. *Gnathoplasma infestans* (Richardiinae), redrawn from Enderlein.

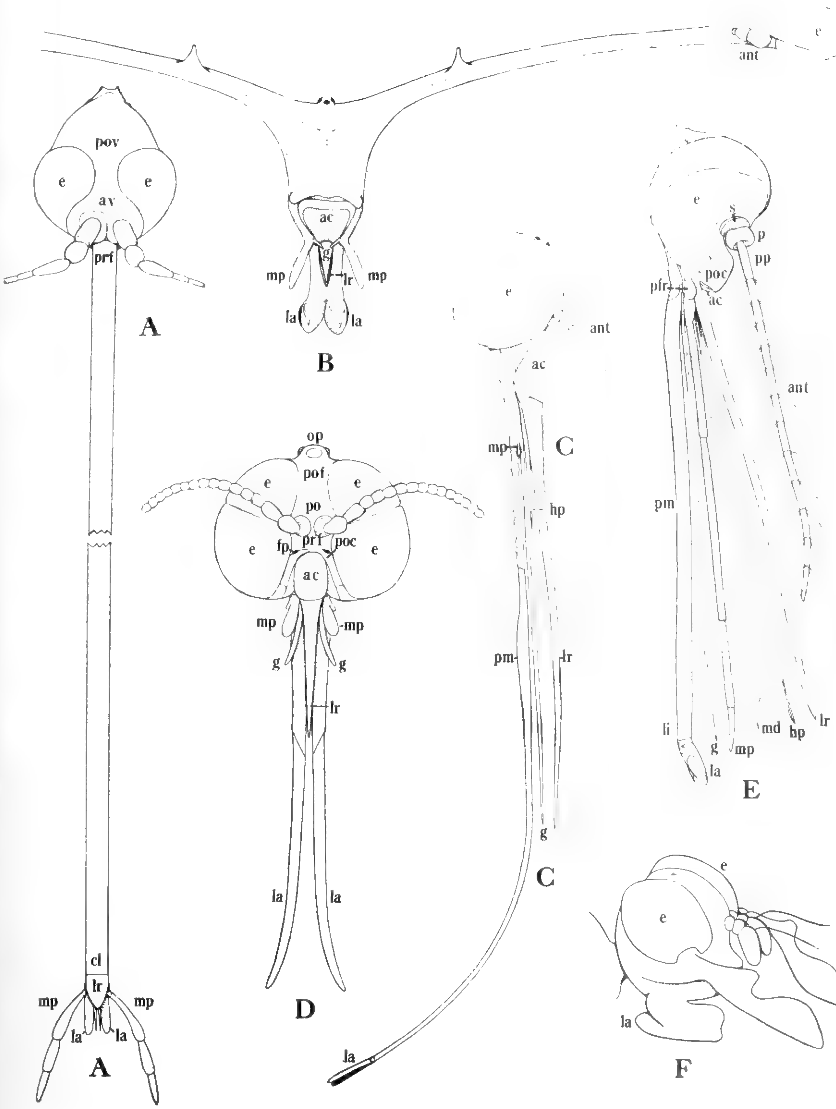
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FIGURE 4. HEAD CAPSULES, SECTIONS OF MOUTH PARTS, ETC.

A. *Glyphidops filosus* (Neriidae).

B. *Rhingia nasica* (Syrphidae).

C. *Cyclopoda sykesi* (Nycteribiidae), cross section of proboscis, after Jobling.

D. *Gnoriste* (Mycetophilidae).

E. *Musca domestica*, lateral view of proboscis.

F. Section of muscid mouth parts.

G. Section of mouth parts (labium omitted) of female tabanid.

H. *Limonia (Geranomyia) rufescens* (Tipulidae).

I. Bifid loops of the pseudotracheae of a fly.

J. *Musca domestica*.

K. Section of pseudotracheae of housefly, after Hewitt.

L. Section of mouth parts of female mosquito.

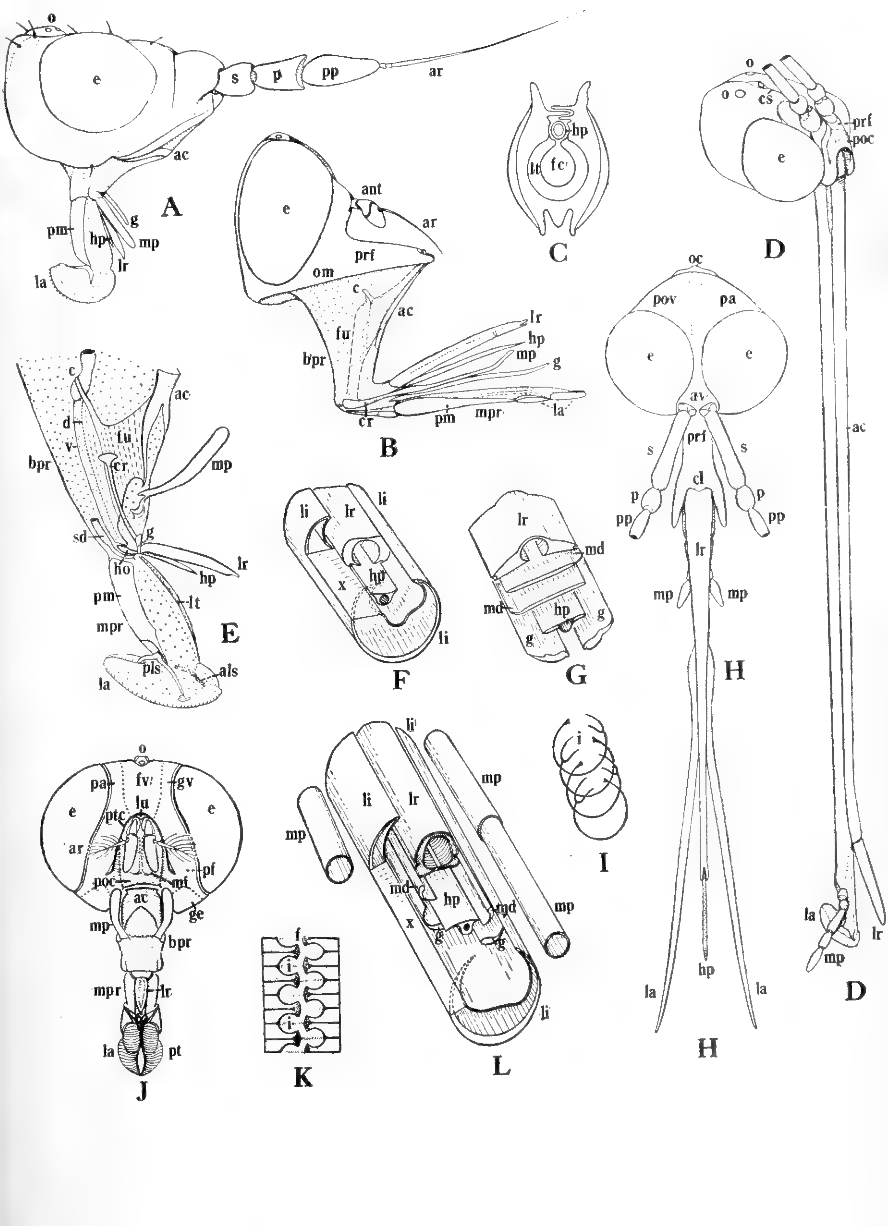
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FIGURE 5. Antennae.

A. A typical trichocerid (*Trichocera*).

B. A bibionid of the *Dilophus* type.

C. A typical psychodid (*Psychoda*).

D. A typical simuliid (*Simulium*).

E. A typical anisopodid (*Anisopus*).

F. *Ceroplatus* (Mycetophilidae).

G. *Asilus* (Asilidae).

H. Male *Malpighia angustipennis* (Tipulidae).

I. *Tabanus* (Tabanidae).

J. *Symphoromyia* (Leptidae).

K. Stratiomyid of *Sargus* type.

L. *Anthrax* (Bombyliidae).

M. *Rachicerus* (Rachiceridae).

N. *Karschomyia viburni* (Cecidomyidae), circumfili of distal segments, after Felt.

O. *Melophagus ovinus*, wingless female (Hippoboscidae).

P. *Ptilocera quadridentata* (Stratiomyidae).

Q. *Elachiptera* (Oscinidae).

R. *Talarocera nigripennis*, male (Tachinidae), after Williston.

S. *Phyllaristomyia fiebrigi* (Tachinidae).

T. *Loxocera cylindrica* (Psilidae).

U. *Cerozodia plumosa*, male (Tipulidae).

V. Male mosquito (based largely on *Culex pipiens*).

W. *Glossina* (Glossinidae).

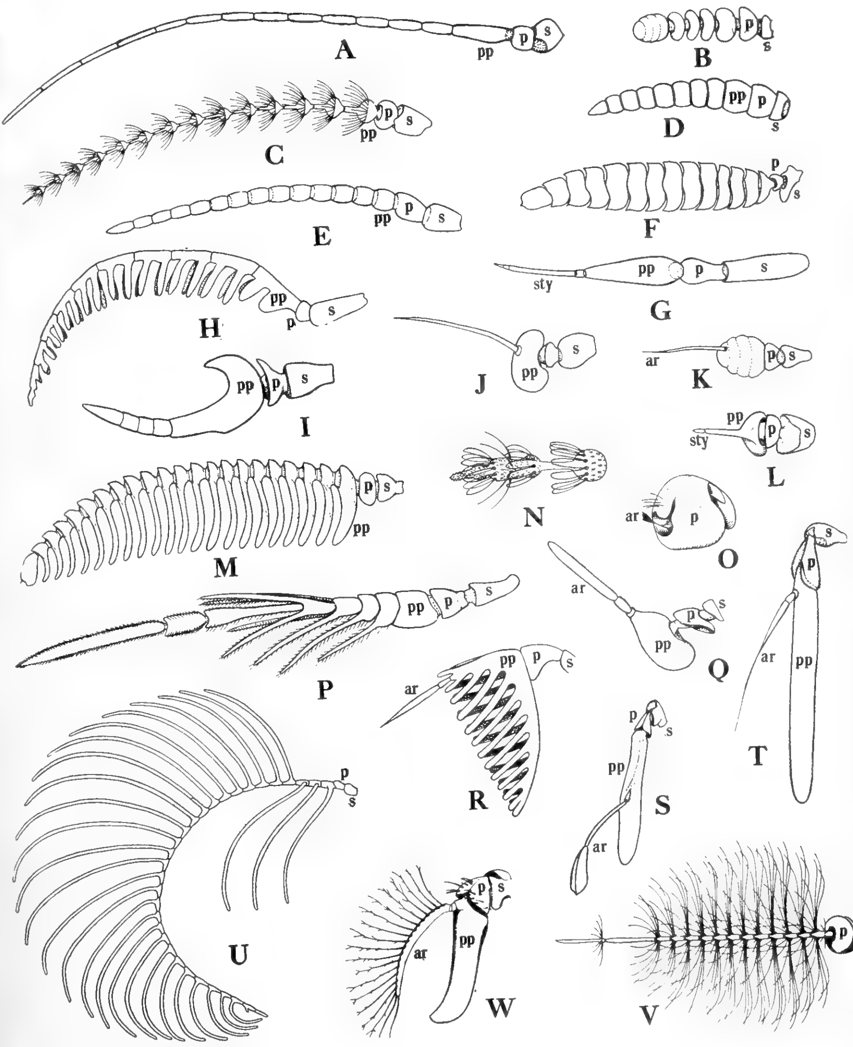

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FIGURE. 6. Lateral View of Thoraces.

A. *Dolichopeza* (*Oropeza*) *tridentata* (Tipulidae).

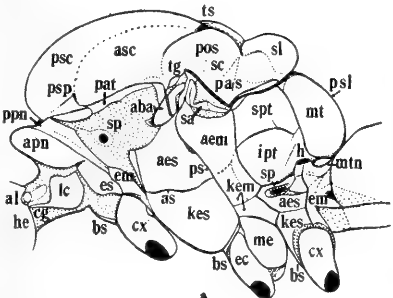
B. *Sciara* (Mycetophilidae).

C. *Musca domestica* (Muscidae).

D. A typical culicid.

E. *Ornithoctona*, winged female (?) (Hippoboscidae).

F. *Melophagus ovinus*, wingless female (Hippoboscidae).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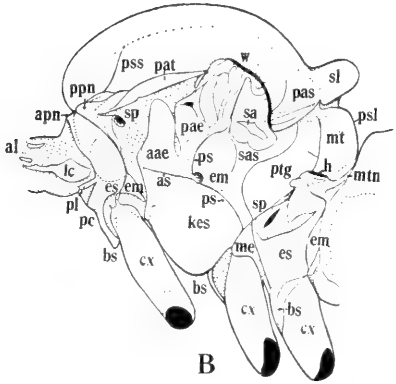
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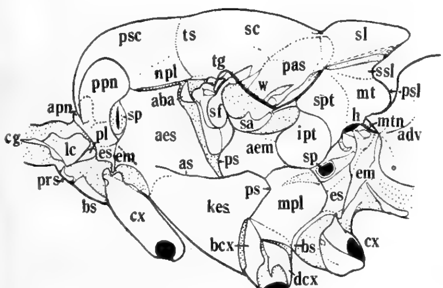
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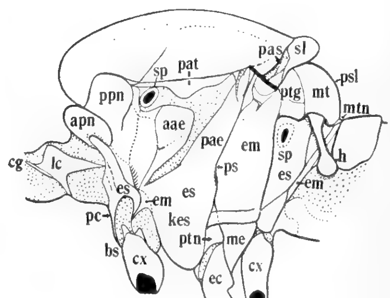
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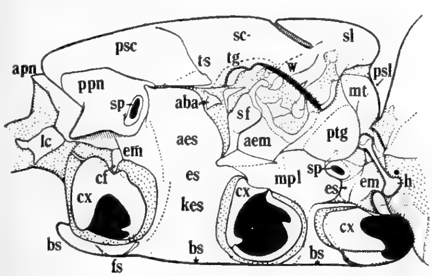
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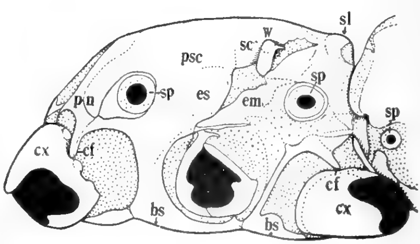
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FIGURE 7. HEADS, THORACES AND MALE GENITALIA.

A. Thorax of *Celyphus obtectus* (Lauxaniidae).

B. Head and prothorax of a female nycteribiid, fore legs cut off.

C. Thorax and abdomen of *Dicranophora furcifera* (Stratiomyidae).

D. Head of *Melanderia mandibulata* (Dolichopodidae).

E. Head of *Braula caeca* (Braulidae).

F. Head of *Strebla vespertilionis* (Streblidae), ventral view.

G. Same, dorsal view.

H. Terminalia of male of *Aedes implacabilis* (Culicidae), dorsal view.

I. Thorax and axillary sclerites of *Tabanus atratus* (Tabanidae). Venation according to interpretation of Tillyard.

J. Terminalia of male of *Metalimnophila maorica* (Tipulidae) dorsal view.

K. Terminalia of male of *Hylemyia antiqua* (Anthomyidae).

L. Aedeagus and apodemes of male of *Phormia regina* (Metopiidae).

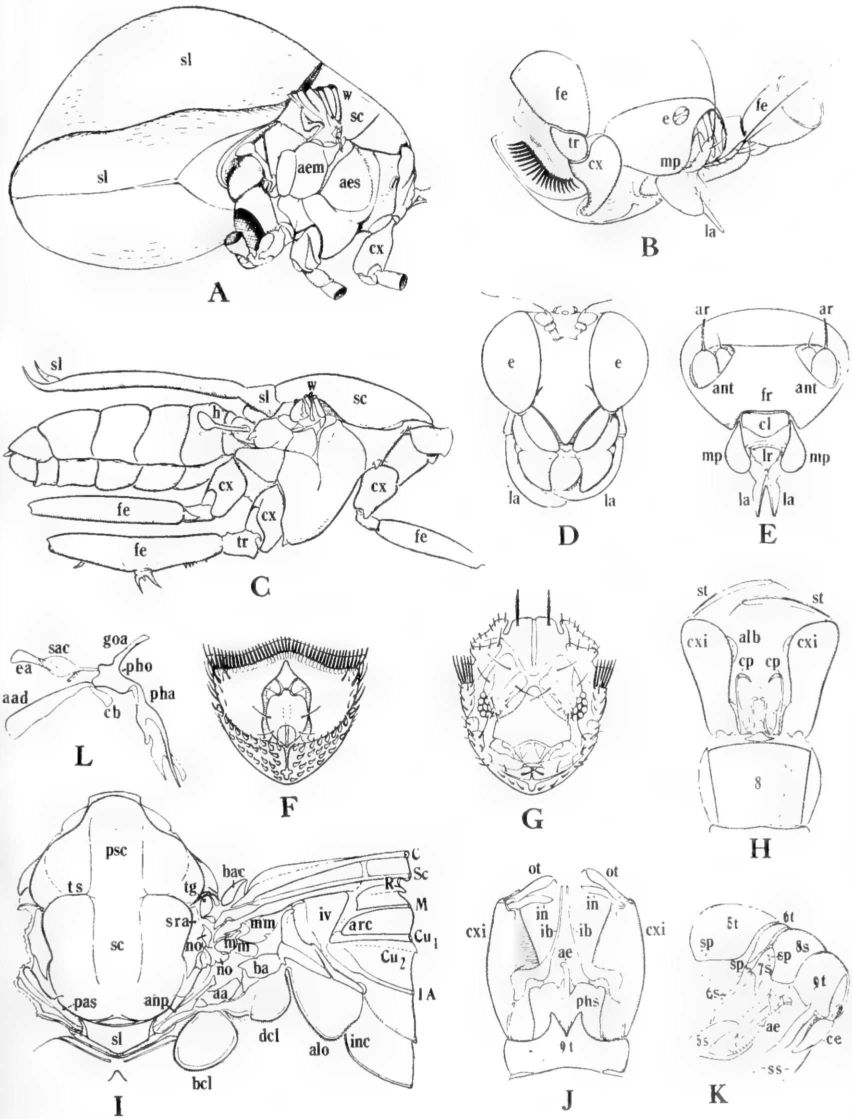
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FIGURE 8. MODIFICATION OF THE LEGS.

A. *Sepedon armipes* (Tetanoceridae), hind leg of male.

B. *Calotarsa ornatipes* (Platypezidae), hind tarsus of male.

C. *Calotarsa calceata* (Platypezidae), hind leg of male.

D. *Rhamphomyia fumosa* (Empidae), hind leg.

E. *Ornithoctona*, winged female (?) (Hippoboscidae), ventral view of tarsus.

F. *Mesembrius* (Syrphidae), fore leg of male.

G. *Chelifera* (Empidae), fore leg.

H. *Hilara* (Empidae) fore tarsus of male.

I. *Dolichopus omnivagus* (Dolichopodidae), fore tarsus of male.

J. *Eumerus obliquus* (Syrphidae), hind tarsus of male.

K. *Mallophora scopifer* (Asilidae), ventral view of distitarsus.

L. *Tabanus atratus* (Tabanidae), ventral view of distitarsus.

M. *Stenochthera* (Ephydridae), fore leg.

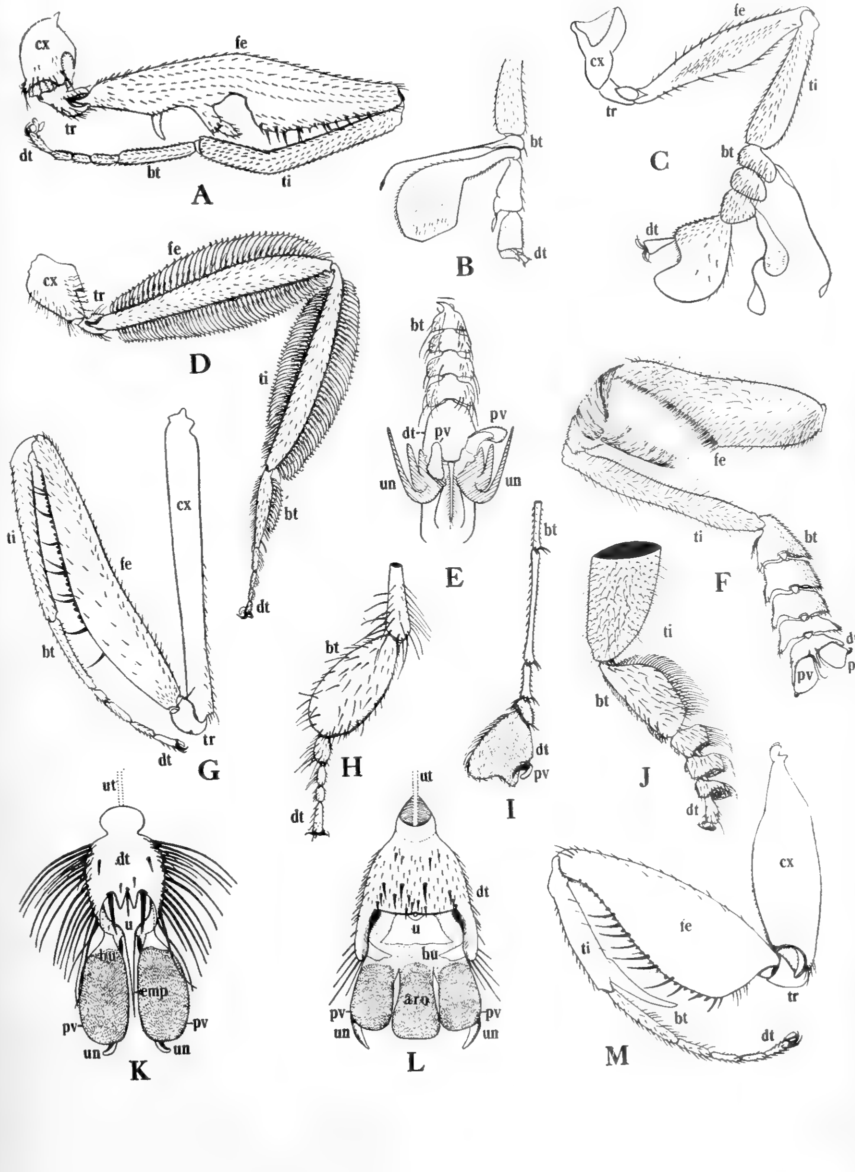
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FIGURE 9. LATERAL VIEWS OF TERMINAL ABDOMINAL STRUCTURES OF FEMALE.

A. *Clytocosmus* (Tipulidae).

B. *Hermetia* (Stratiomyidae).

C. Anopheline mosquito, after Gerry.

D. *Tephritis* (Trupaneidae).

E. *Musca domestica*, dorsal view.

F. *Chrysopilus thoracicus* (Leptidae).

G. *Hermetia* (Stratiomyidae), ventral view.

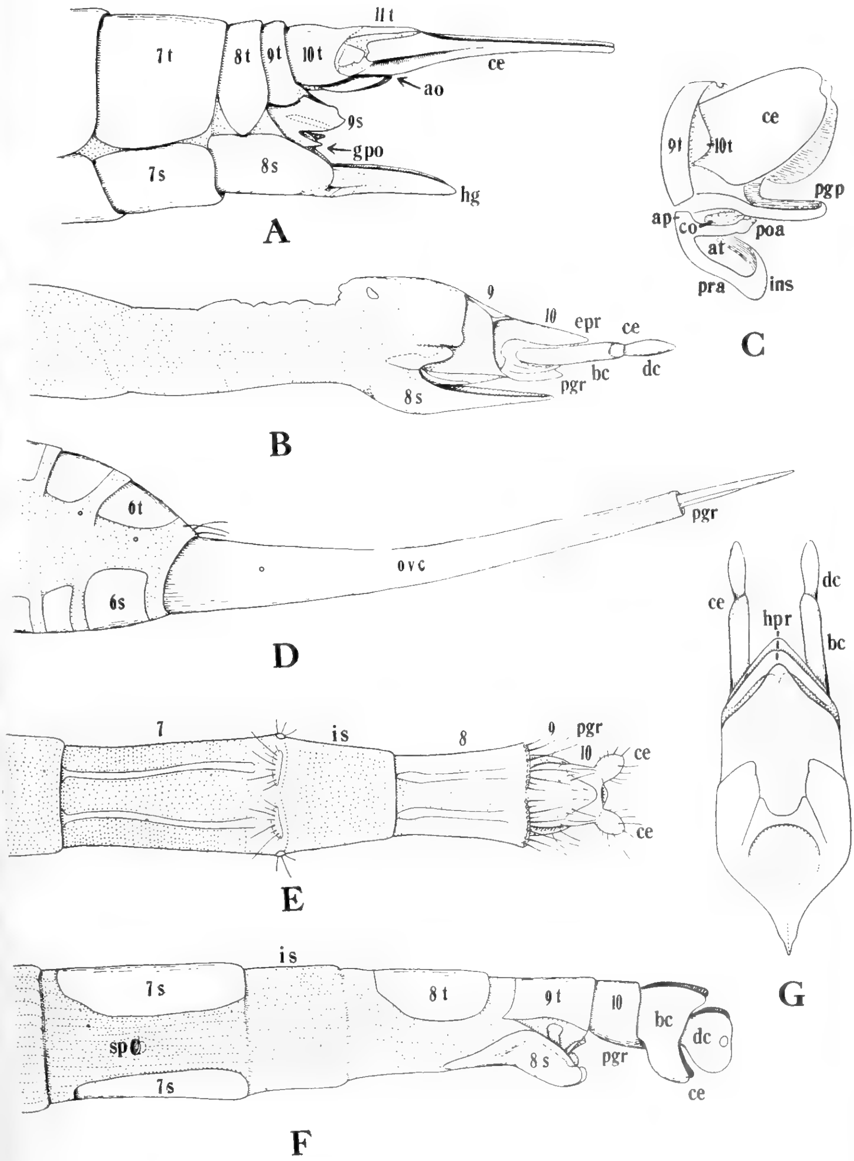
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FIGURE 9a. Posterior Abdominal Structures.

A. Diagrammatic representation of the internal anatomy of the genital system of a male metopiid (calliphorid) fly, based on *Phormia regina*, showing the looping up of the vas deferens and ejaculatory duct over the top of the rectum, before discharging through the phallosome or aedeagus. The gonapophyses, etc., are slightly displaced forward to show the base of the aedeagus.

B. Lateral view of the postabdomen of a female syrphid, *Eristalis arbustarum*, showing the spiracle of the seventh abdominal segment in its normal position.

C. Diagrammatic figure of the postabdomen of a female anthomyid fly, *Hammomyia paludis*, showing the migration of the seventh spiracle forward into the intersegmental membrane between the sixth and seventh abdominal segments.

D. Lateral view of the postabdomen of a female metopiid (calliphorid) fly, *Cynomya cadaverina*, showing the displaced seventh spiracle now borne in the sixth abdominal tergite, which also bears the sixth spiracle as well.

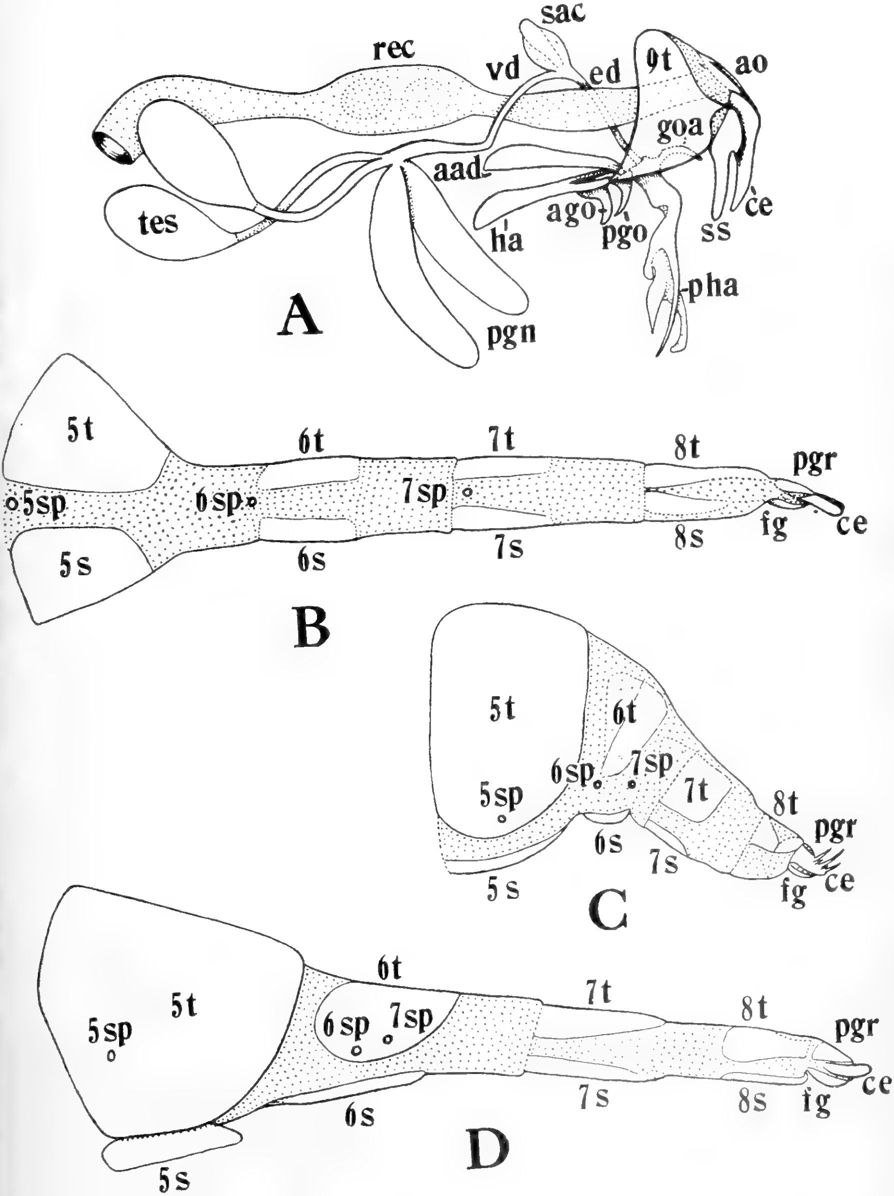
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FIGURE 10. LATERAL VIEWS OF TERMINALIA.

A. *Tipula borealis*, male (Tipulidae).

B. *Calobata univitta*, male (Calobatidae), ventral view.

C. *Occemya*, female (Conopidae).

D. *Dolichopus fulvipes*, male (Dolichopodidae).

E. *Phormia regina*, male (Metopiidae).

F. *Calobata pallipes*, female (Calobatidae).

G. *Diogmites*, female (Asilidae).

H. *Glyphidops filosus*, male (Neriidae).

I. *Cardiacephala longipes*, male (Calobatidae).

J. *Anacampta pyrrhocephala* (Otitidae), aedeagus of male, after Cole.

K. *Bittacomorpha sp.*, male (Ptychopteridae).

L. *Musca domestica*, male (Muscidae).

M. *Scellus venustus*, male (Dolichopodidae).

N. *Astochia*, male (Asilidae).

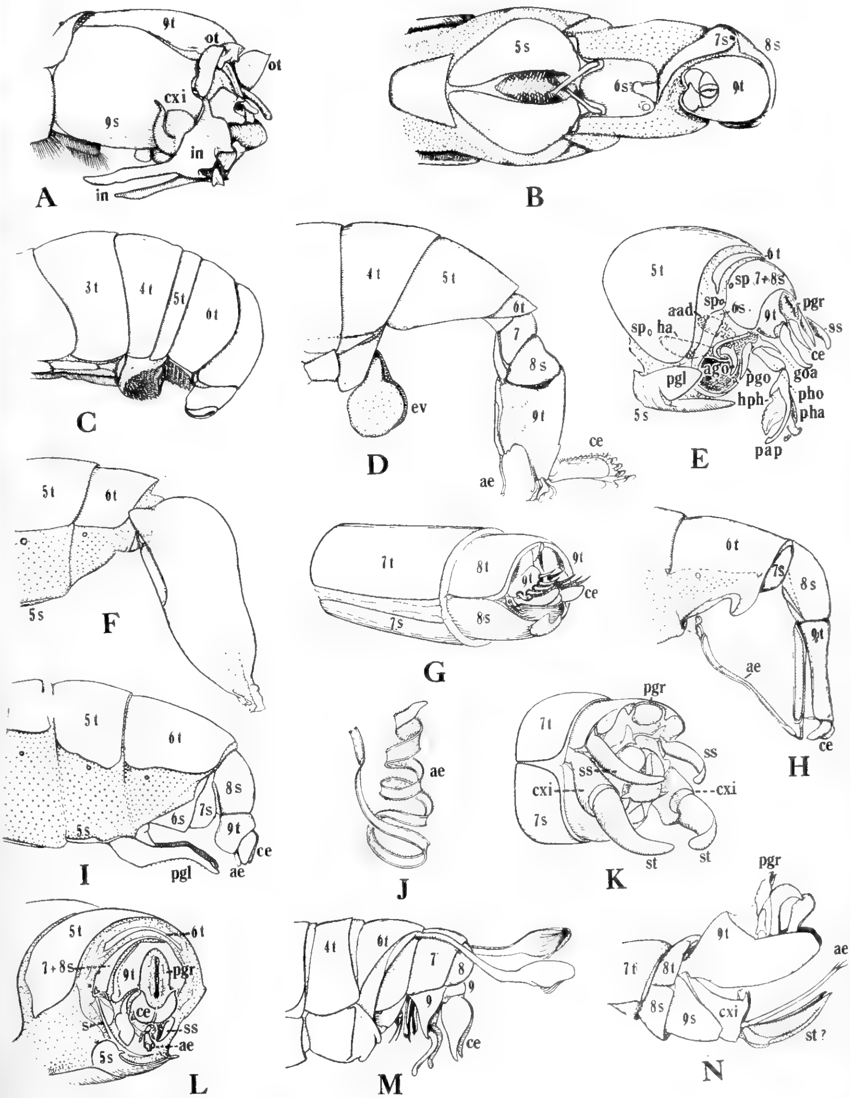
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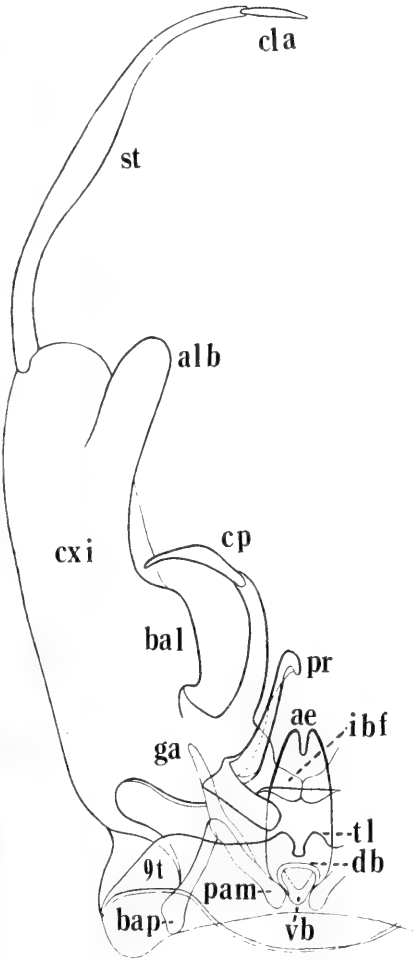
FIGURE 11. TERMINALIA OF MALE MOSQUITOES.

A. *Aedes stimulans* (Culicidae), ventral view of half of the male genitalia in situ. Redrawn from Matheson.

B. Longitudinal section of terminalia of *Aedes* (Culicidae). Redrawn from Edwards.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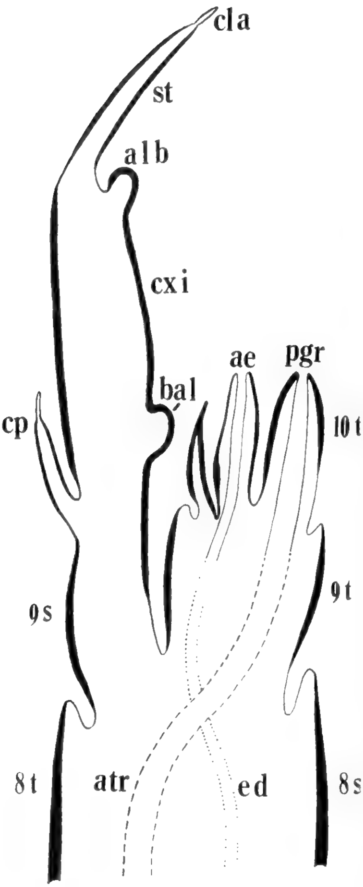
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FIGURE 12. LATERAL VIEWS OF MALE TERMINALIA.

A. *Rhagio vertebratus* (Leptidae).

B. *Argyra* sp. (Dolichopodidae), redrawn from Crampton, 1936.

C. *Ptecticus* sp. (Stratiomyidae).

D. *Mesograpta marginata* (Syrphidae), ventral view.

E. *Pipunculus* sp. (Pipunculidae).

F. *Sericomyia chrysotoxoides* (Syrphidae).

G. *Dilophus* sp. (Bibionidae).

H. *Caelopa frigida* (Caelopidae).

I. *Pyrgota undata* (Pyrgotidae).

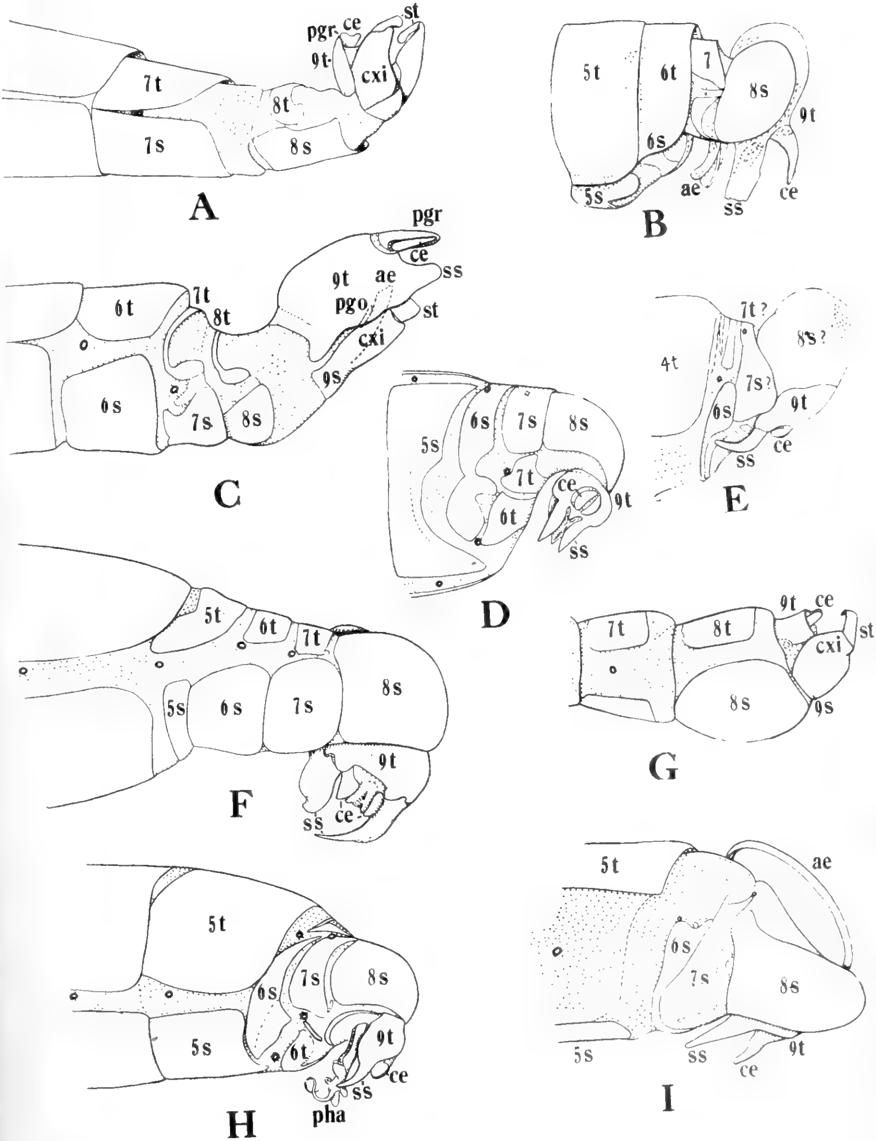
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FIGURE 13. LATERAL VIEWS OF TERMINALIA OF MALE CYCLORRHAPHA.

A. *Paragus bicolor* (Syrphidae), redrawn from Crampton, 1936.

B. *Neoleria crassipes* (Helomyzidae), redrawn from Crampton, 1936.

C. *Anorostoma marginatum* (Helomyzidae).

D. *Hylemyia antiqua* (Anthomyidae), redrawn from Crampton, 1936.

E. *Phormia regina* (Metopiidae), redrawn from Crampton, 1936.

F. *Musca domestica* (Muscidae).

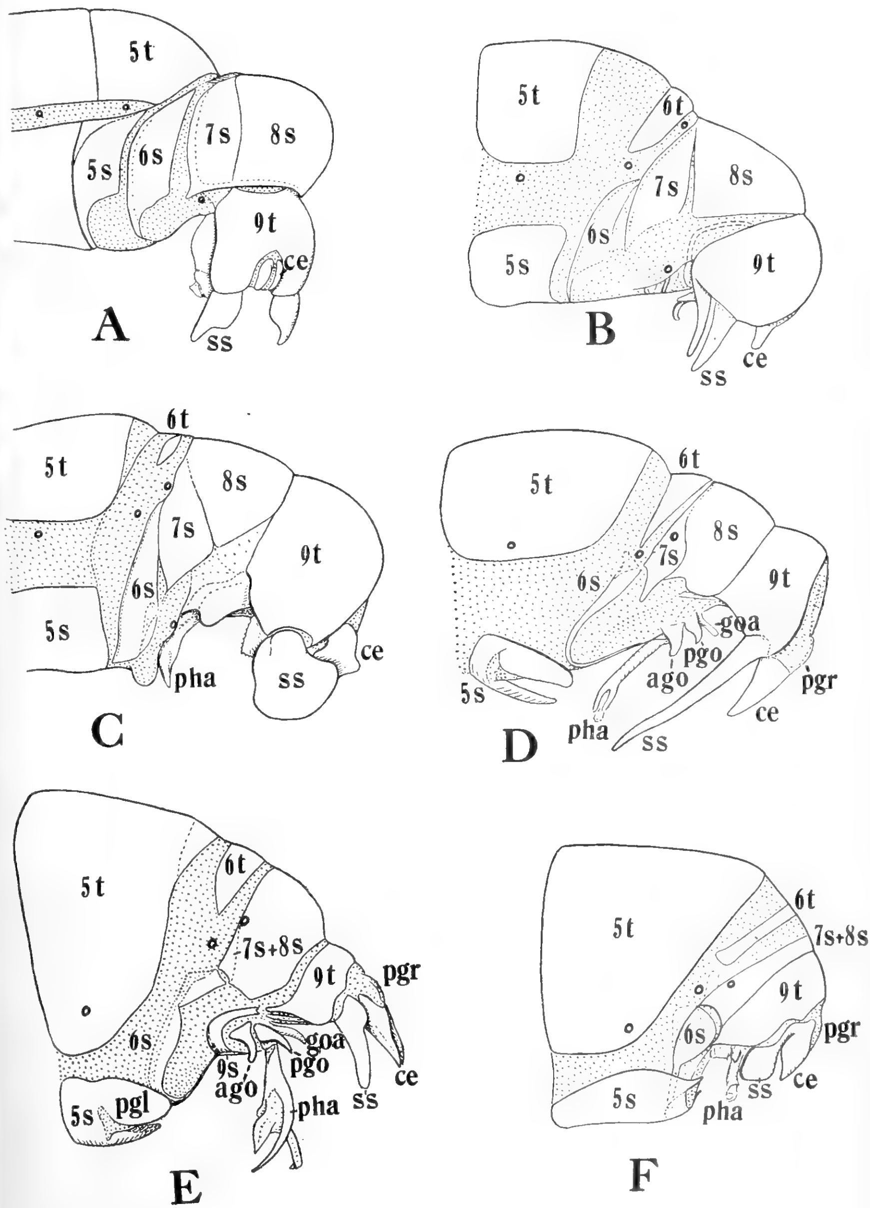
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FIGURE 14. LATERAL VIEWS OF TERMINALIA OF MALE CYCLORRHAPHA.

A. *Micropeza* sp. (Micropezidae).

B. *Sarcophaga faculata* (Metopiidae).

C. *Calobata pallipes* (Calobatidae).

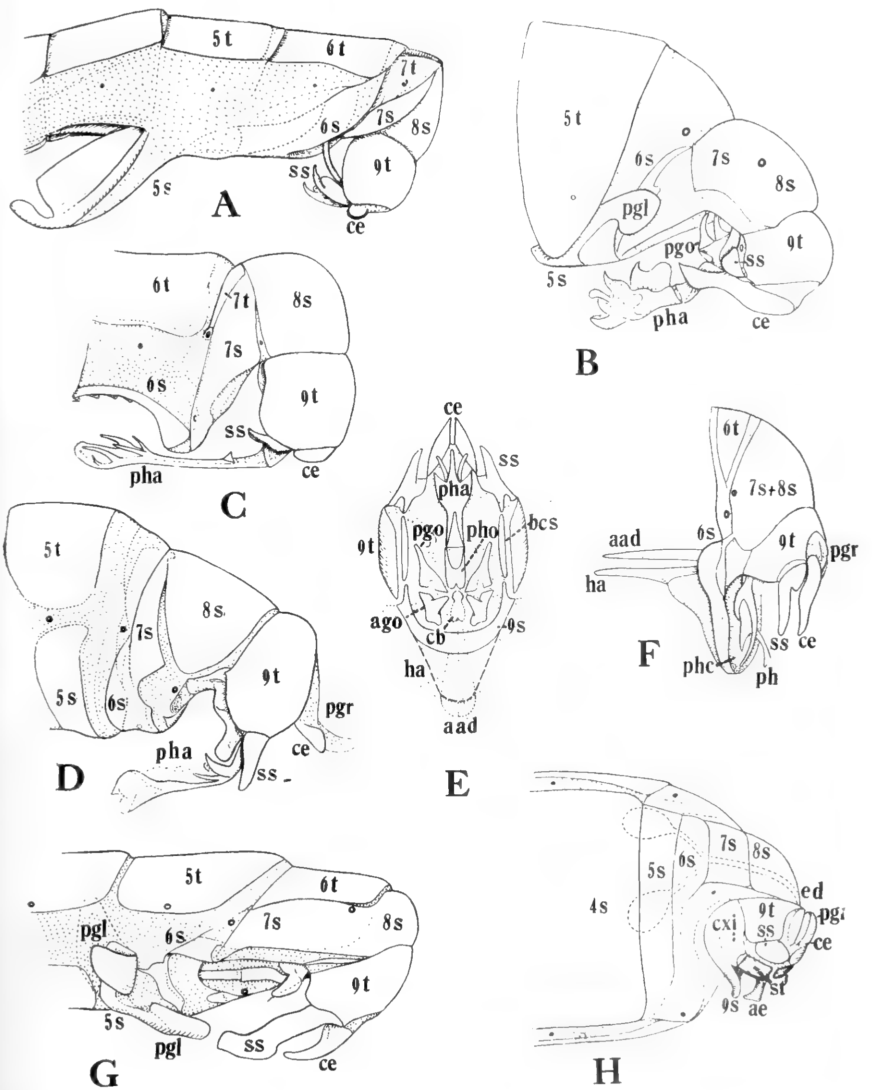
D. *Suillia limbata* (Helomyzidae).

E. Diagram of arrangement of parts in *Phormia regina*, ventral view.

F. *Pollenia rudis* (Metopiidae).

G. *Parallelomma* sp. (Cordyluridae).

H. *Syrphus rectus* (Syrphidae).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TAXONOMY

Wing Venation

R. B. FRIEND
Connecticut Agricultural Experiment Station

In view of the fact that the collaborators in the present work have not used the same terminology in naming the wing veins, although within any one family uniformity exists, it is necessary to discuss the wing venation briefly in order to clarify a condition which may be confusing to those not familiar with the classification of Diptera. No attempt is made to evaluate the merits of any one system, nor to arrive at any decision on the true homologies of veins, either within the order or with the veins of other orders of insects. It may be found, however, that the key to families gives a vein one name while the classification of the family itself, by another author, calls the vein something else. It will also be noticed that in one family the veins receive names totally different from the names employed in describing another family, although the actual structure of the wing in these two families is strikingly similar. The system of terminology an author uses is a personal matter, and it has not been considered expedient to attempt to impose a uniform system on all collaborators. Such an attempt would probably fail. The accompanying illustrations of the wings of several flies will, it is hoped, be of some assistance in this matter as well as an aid in using the key to families.

The Comstock-Needham system is used in describing the wing venation of most insects and is the best known terminology. It is thoroughly discussed by Comstock (The Wings of Insects, 1918). According to this author the wing venation of primitive Diptera departs from the hypothetical primitive type of insect wing venation only in the reduction of the number of veins by coalescence or atrophy. Neither accessory nor intercalary veins are ever developed, and only the principal cross veins are present. In the more specialized Diptera adjacent veins have frequently coalesced.

The marginal vein of the wing is the costa (C). It is usually more conspicuous along the anterior margin of the wing.

The subcosta (Sc) branches once in some primitive Diptera, as in *Protoplasa* (Figure 15). It may end in the costa, a more common condition, or in the radius, or the tip may be evanescent, or the entire vein may be missing.

The radius (R) retains all five branches in the Psychodidae and in the Tanyderidae, as *Protoplasa*. In most forms the radial sector (Rs) has less than the primitive number of four branches, the reduction even extending to the single-branched condition. In some

species this reduction has occurred by the coalescence of the first and second branches of the sector (R_2 and R_3), in others by the coalescence of the third (R_4) and fourth (R_5) branches.

Comstock believes the media (M) has been reduced from its primitive four-branched condition by the coalescence of the fourth branch (M_4) with either the third (M_3) or the first cubitus (Cu_1). The media never has four distinct branches in Diptera. A further reduction of the media may occur by coalescence of the first (M_1) and second (M_2) branches, by the coalescence of the third branch with the first cubitus, or by atrophy.

The cubitus (Cu) in many species is fused to a greater or less extent with the second anal vein (2A).

There are only two anal veins (1A and 2A), and the first of these, when present, is usually represented by a very indistinct suture-like vein just behind the cubitus.

The cells of the wing, bounded by the veins, are named after the vein bounding the cell anteriorly. The reduction in the number of veins has obviously reduced the number of cells. Where two veins coalesce, the cell behind the coalescence is named after the more posterior of the two veins.

The system of Comstock and Needham as above described has been modified by Tillyard (see "Insects of Australia and New Zealand"). This author's basic scheme of dipterous venation differs from the Comstock-Needham system in that the media is four-branched, with consequent changes in the names given the posterior veins. Thus Cu_1 becomes M_4, Cu_2 becomes Cu_1, 1A becomes Cu_2, 2A becomes 1A, and the somewhat evanescent vein in the axillary region becomes 2A. The cell in the center of the wing, Comstock's first M_2, is called the median cell by Tillyard.

The wing of *Tabanus*, shown in Figure 17, illustrates the systems of Loew (used in the Key to Families of the present work) and of Tillyard. The terminology applied to the cells is sufficiently explained in the figure. This may be compared with the other wings illustrated in Figures 15 to 17, where Tillyard's terminology is used. The discal cell is Tillyard's median cell (1st M_2 in the Tipuloidea of this volume).

Further modifications of the terminology have been made for the veins in the anterior part of the wing by Shannon and Bromley (Insec. Inscit. Mens. 12: 137-140, 1924) and by Alexander (Trans. 4th Inter. Cong. Ent. 1928, vol. 2: 700-707). Shannon and Bromley state that in certain Brachycera the first branch of the radial sector is a branched vein, but the posterior of the two branches, R_3, has been deflected caudad and fused with R_4 to form a vein R_{3+4}. In most Brachycera the basal connection is lost, but in some forms it is represented by a complete transverse element or a spur. The venation of the Asilidae in the present work is given this interpretation. Alexander has given another interpretation of the radial field, according to which almost all higher groups of Diptera above the Tip-

uloidea have lost R_2 by atrophy, and in groups above the Tanyderidae R_2 has swung forward, forming R_{1+2}. R_2 persists as a cross vein only in Nemestrinidae and certain lower groups. In most lower Brachycera R_4 has become attached basally to R_{2+3}, and the basal connection may be lost entirely or represented by a spur. In all Brachycera in which the free tip of R_4 is retained, the connection with R_5 is by a supernumerary cross vein which is present in several Tanyderidae, Tipulidae, and lower Brachycera. The terminologies of Comstock and Needham, Shannon and Bromley, and Alexander in regard to the radial field of the Asilidae are compared below. The system of Alexander is followed in the tipuloid families of the present work.

Comstock-Needham	Shannon and Bromley	Alexander
R_1	R_1	R_{1+2}
R_{2+3}	R_2	R_3
R_4	R_{3+4}	R_4
R_5	R_5	R_5

Inasmuch as the first volume of the Diptera of Connecticut includes no families beyond the Tipuloidea, a further discussion of the wing venation is not necessary here.

Wing Veins

Tillyard's Modification of Comstock-Needham	Symbol	Loew
Costa	C	Costa
Subcosta	Sc	Auxiliary
Radius	R	
Main stem	R_1	First longitudinal
Sector	Rs	
First branch	R_2	Second longitudinal
Second branch	R_3	
Third branch	R_4	Third longitudinal
Fourth branch	R_5	
Media	M	
First branch	M_1	Fourth longitudinal
Second branch	M_2	
Third branch	M_3	Fifth longitudinal (distal part)
Fourth branch	M_4	
Cubitus	Cu	
First branch	Cu_1	Fifth longitudinal (basal part)
Second branch	Cu_2	
First anal	1A	Sixth longitudinal
Second anal	2A	Axillary
Humeral crossvein	hm	Humeral crossvein
Radio-medial crossvein	rm	Anterior crossvein
Intermedial crossvein	im	Posterior crossvein
Medio-cubital crossvein	m-cu	Discoidal crossvein

In the figures the Tillyard modification of the Comstock-Needham system of nomenclature has been substituted for the nomenclature employed by the original author. For a comparison of this with the system of Loew see Figure 15 (Rhagionidae) and Figure 17 (Tabanidae).

FIGURE 15. WINGS OF DIPTERA.

1. Tanyderidae. *Protoplasa*, from Williams, Jour. N. Y. Ent. Soc. 41, 1933.

2. Blephariceridae. *Blepharicera*, from Curran, No. Amer. Dipt., 1934.

3. Simuliidae, *Simulium*.

4. Chironomidae, *Protenthes*, from Malloch, Bull. Ill. State Lab. Nat. Hist. X, Art. VI, 1915.

5. Culicidae, *Aedes*, from Matheson, Mosquitoes of N. A., 1929. Courtesy of Chas. C. Thomas, Publisher, Springfield, Ill.

6. Cecidomyidae, *Catocha*, from Curran, No. Amer. Dipt., 1934, after Felt.

7. Rhagionidae, *Chrysopilus*, from Leonard, Mem. Amer. Ent. Soc. 7, 1930.

8. Mydaidae, *Mydas*, from Comstock, Introd. to Ent., 1924. Comstock Pub. Co., Ithaca.

9. Asilidae, *Diogmites*, from Bromley, ms.

10. Bombyliidae, *Metacosmus*, from Curran, No. Amer. Dipt., 1934.

11. Scenopinidae, *Scenopinus*, from Comstock, Introd. to Ent., 1924. Comstock Pub. Co., Ithaca.

12. Dolichopidae, *Dolichopus*, from VanDuzee, Cole and Aldrich, U. S. Mus. Bull. 116, 1921.

13. Lonchopteridae, *Lonchoptera*, from Curran, No. Amer. Dipt., 1934.

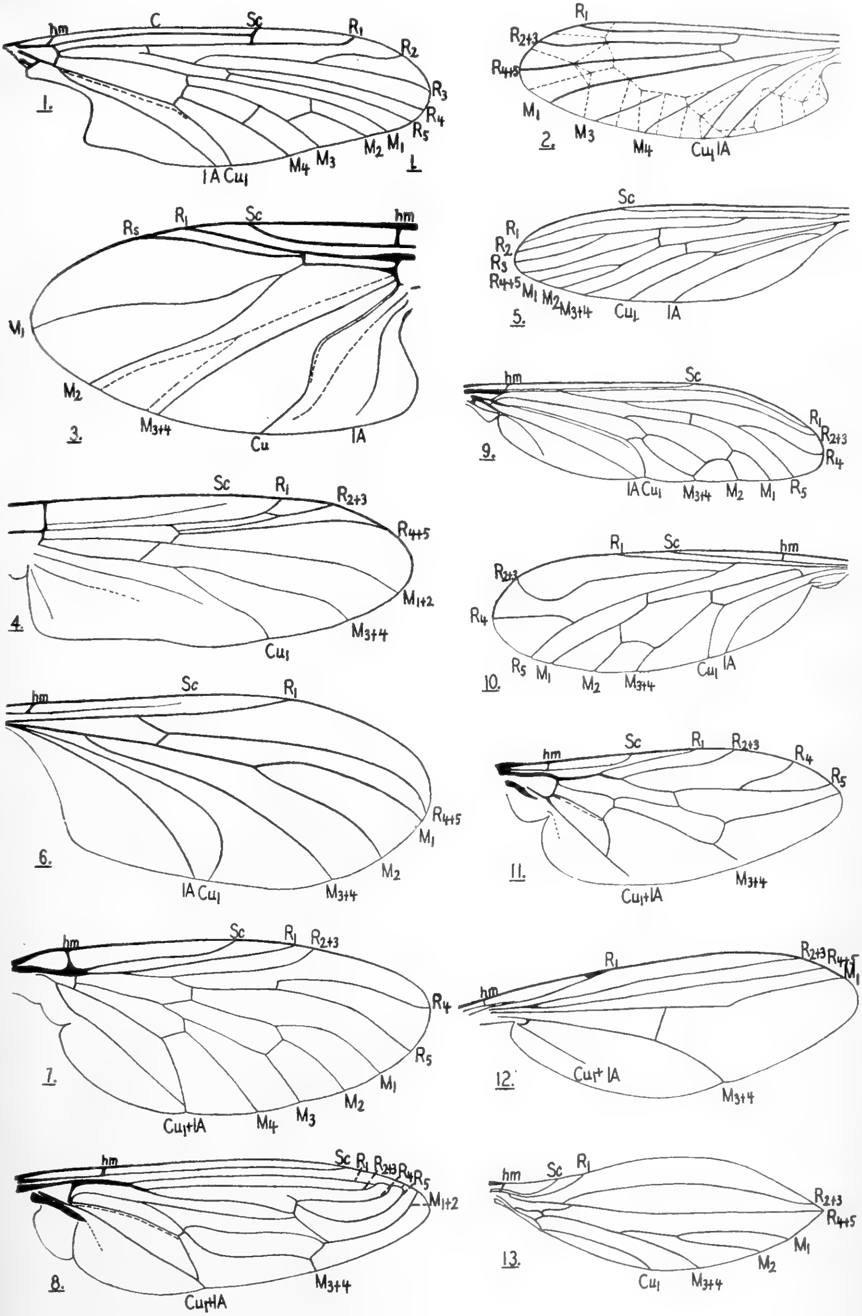

hm
C
Sc
R1
R2
R3
R4
R5
M1
M2
M3
M4
1A Cu1
1.
R1
R2+3
R4+5
M1
M3
M4
Cu1 1A
2.
Rs
R1
Sc
hm
M1
M2
M3+4
Cu
1A
3.
Sc
R1
R2
R3
R4+5
M1 M2 M3+4
Cu1
1A
5.
Sc
R1
R2+3
R4+5
M1+2
M3+4
Cu1
4.
hm
Sc
R1
R2+3
R4
R5
M1
M2
M3+4
1A Cu1
9.
R1
Sc
hm
R2+3
R4
R5
M1
M2
M3+4
Cu1
1A
10.
hm
Sc
R1
R4+5
M1
M2
M3+4
1A Cu1
6.
hm
Sc
R1
R2+3
R4
R5
M3+4
Cu1+1A
11.
hm
Sc
R1
R2+3
R4
R5
M1
M2
M3
M4
Cu1+1A
7.
R1
R2+3 R4+5
M1
hm
Cu1+1A
M3+4
12.
hm
Sc R1 R2+3 R4 R5
M1+2
M3+4
Cu1+1A
8.
hm
Sc
R1
R2+3
R4+5
M1
M2
M3+4
Cu1
13.

FIGURE 16. WINGS OF DIPTERA.

14. Phoridae, from Brues, ms.

15. Platypezidae, *Platypezoides*, from Johnson, Occ. Papers Boston Soc. Nat. Hist. v. 5, 1923.

16. Syrphidae, *Syrphus*, from Metcalf, Ohio Biol. Surv. I, 1913.

17. Empidae, *Empis*, from Melander, Trans. Amer. Ent. Soc. 28, 1902.

18. Therevidae, *Psilocephala*, from Cole, Proc. U. S. Nat. Mus. 62, Art. 4, 1923.

19. Trupaneidae, *Rhagoletis*, from Lathrop and Nickels, U. S. D. A. Tech. Bull. 275, 1932.

20. Conopidae, *Physocephala*, from Comstock, Introd. to Ent., 1924. Comstock Pub. Co., Ithaca.

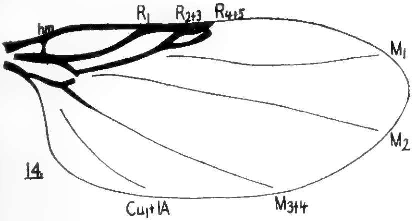
21. Otitidae, *Chaetopsis*, from Blanton, Jour. Ec. Ent. 31, 1938.

22. Lauxaniidae, *Lauxania*, from Curran, No. Amer. Dipt., 1934.

23. Drosophilidae, *Drosophila*, from Sturtevant, The No. Amer. Species of Drosophila, 1921.

24. Asteiidae, *Asteia*, from Aldrich, Psyche 22, 1915.

25. Agromyzidae, *Agromyza*, from Phillips, Jour. Agri. Res. 2, 1914.



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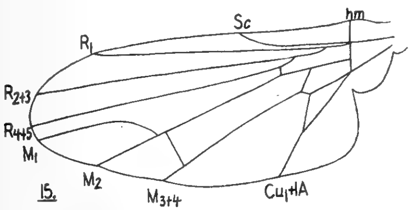

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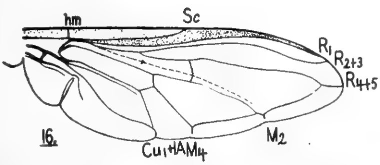

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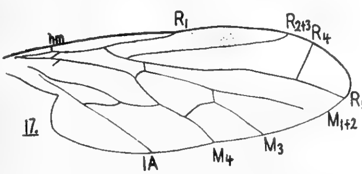

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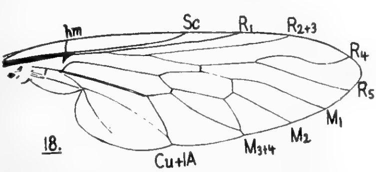

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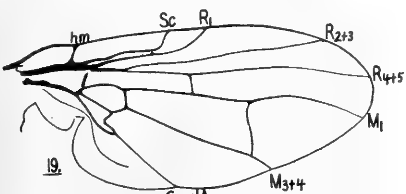

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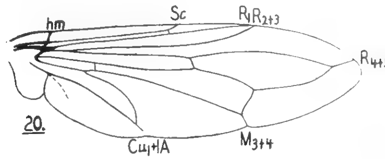

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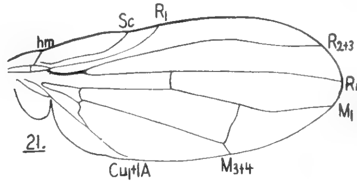

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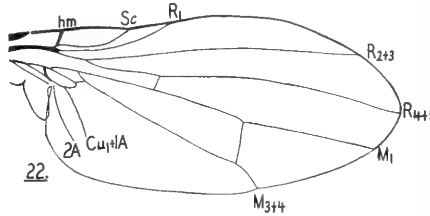

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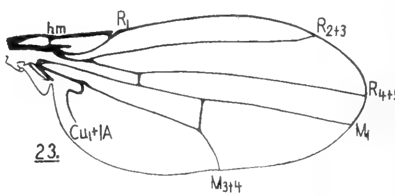

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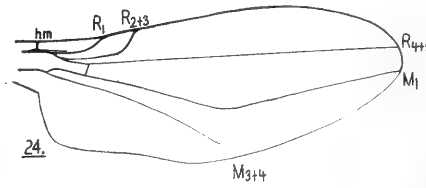

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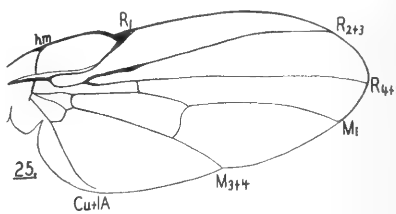

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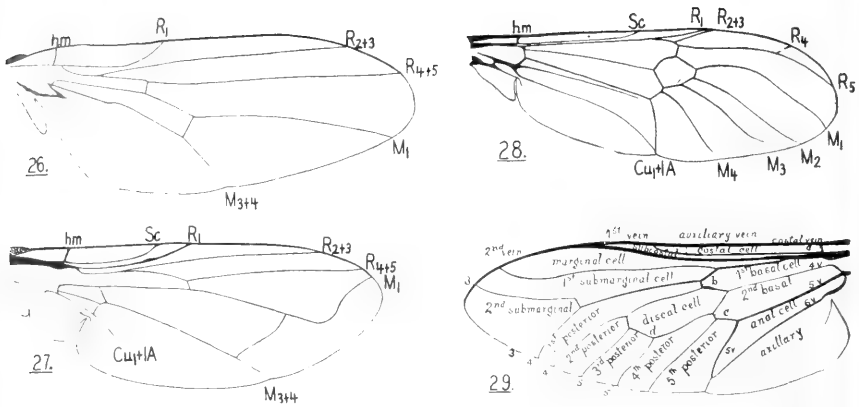

FIGURE 17. Wings of Diptera.

26. Chloropidae, *Chloropisca*, from Curran, No. Amer. Dipt., 1934.

27. Muscidae, *Musca*, from Graham-Smith, Flies in Relation to Disease, 1913. Cambridge University Press.

28. Stratiomyidae, *Ptecticus*.

29. Tabanidae, *Tabanus*, from Curran, No. Amer. Dipt., 1934.

Key to Families

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In view of the fact that there are very few families of North American Diptera that do not occur in Connecticut the following key contains all of the families at present known from this continent. It differs only slightly from the key published in "The Families and Genera of North American Diptera," the family Cryptochaetidae being added, and the Asteiidae being shifted to a position where it is more readily separated.

It must be recognized that restriction of families and the grouping of genera together depends to a very large degree upon the personal opinions of those who have spent many years studying insects and that because of human frailties it is very seldom that two authorities will agree in all respects. There are some students who would divide the order into many more families than I recognize while others would reduce the number. The future may result in the recognition of many more families since the present tendency is to "split". In actual practice the number of families recognized is really of little importance provided we can determine our specimens with the least amount of effort. There can be little doubt that too great "splitting" makes the determination of specimens more difficult. It would seem to be best to place two or more groups of genera together under a single family name than to recognize them as distinct families that can be separated only with difficulty and sometimes with doubt. If the genera concerned are grouped together it is, on the face of it, much easier to run them through a single key than to worry for hours as to whether they have been assigned to the proper family by the worker, who may be entirely unacquainted with the group of flies for one or more of which he is attempting to find a name. This question has been put very concisely by many entomologists in the following words: "I like to know a syrphid when I see one." It might well refer to a tachinid, a tabanid or any other family.

On another point there may be disagreement. This has to do with the formation of family names. There are some entomologists who claim that the name is to be formed from the "root" of the family name. As an example of this we may take Dolichopus which, from the "root", becomes Dolichopodidae. If we adhere to the "International" rules this spelling is wrong since family names are to be formed by dropping the final vowel and following consonants and adding idae—the family designation. From the viewpoint of the Latin scholar this latter method may be outrageous but to the average student of entomology it is a simple, clear rule that can be followed without difficulty. It also has the advantage that it means fewer letters on a label and does not require a knowledge of ancient languages in order to determine the proper ending of a family name.

The choice of a family name is also a matter of controversy. One school would retain old names used for a family regardless of almost any circumstance. The Trupaneidae may be cited as an example. Trypetidae would be retained on the ground that it was first used. This is, I think, carrying the law of priority to a place where it is certain to produce confusion rather than lessen it. If we search the literature we may find, tomorrow, that some one used Tephritidae before Trypetidae, and the next day another name may show up. In addition to this, what is to happen when one or more genera, which once carried a group name (and there are many of them), is transferred to another family? One of the names must be relegated to the background and it may be the better known of the two. Even the Trypetidae may disappear in due time because the characters separating this family and the Otitidae are very weak in some South American forms. It would seem that the only logical way to secure stability of family names is to form the name from the oldest included genus. In this way stability will be reached quickly.

In the present work certain names are retained that should properly be changed on the basis of the oldest generic designation. The proper place to make such changes should be in a catalogue or a revision of the order.

How to Use the Keys

The use of keys is not a difficult matter but there may be some who have not had experience with them. Some keys may not be altogether simple and may not run as smoothly as others. To find the genus to which your specimen belongs turn to the table of families and read over couplet 1. Two alternatives are given: the insect must go in either section. If it has large wings you go to couplet 2 and you repeat the process until it is found that your specimen comes to a section where it agrees with the diagnosis ending in a family name. You have now found the "family", but to be sure read over the other alternative so that the characters in both may be checked. Now turn to the family indicated and continue in the same way until the genus and species is reached.

It should be remembered that keys are merely guides and the fact that a species traces out to a certain place in a key is no guarantee that it actually belongs there. If one is familiar with the genera of a family he may be reasonably certain either that the insect belongs where it traces or that it is quite different; in either case he should check with descriptions of genera or species not included in the key, or with the genus or species included, either by means of determined specimens or with descriptions. If a specimen does not seem to agree with the genus or species to which it traces, check back and try one of the other alternatives, since there may have been an error in interpretation of the characters used or the specimen may be one that is somewhat aberrant.

TABLE OF FAMILIES

1. Wings absent or greatly reduced .... 5[illegible]
   Wings present, rarely reduced 2
2. Antennae composed of six or more freely articulated segments 3
   Antennae composed of not more than five freely articulated segments, the third segment sometimes complex, usually bearing a style or arista 22
3. Mesonotum with an entire V-shaped suture 4
   Mesonotal suture transverse, not V-shaped 7
4. Ocelli absent 5
   Ocelli present .... **TRICHOCERIDAE**
5. Only one anal vein reaches the wing margin 6
   Two anal veins reach the wing margin.................... **TIPULIDAE**
6. Second and third veins each with two branches (radius 5-branched). **TANYDERIDAE**
   Second and third veins with only three branches reaching the wing margin (radius 4-branched) .... **PTYCHOPTERIDAE**
7. Wings without a network of folds or creases 8
   Wings with a network of fine folds or creases...... **BLEPHARICERIDAE**
8. Ocelli present 9
   Ocelli absent 14
9. Costa continuing around the wing, although weakened behind. **CECIDOMYIDAE**
   Costa ending at or near the wing-tip 10
10. Discal cell present 21
    Discal cell absent 11
11. Tibiae with apical spurs 12
    Tibiae without apical spurs, though sometimes produced spur-like..... 11a
11a. Basal cells open apically; only anterior veins heavy...... **SCATOPSIDAE**
    Basal cells, long, closed apically; veins strong (Axymyia). **ANISOPODIDAE**
12. Eyes more or less connected by a projection above the base of the antennae .... **SCIARIDAE**
    Eyes separated 13
13. Antennae placed below the compound eyes, usually close to the oral margin .... **BIBIONIDAE**
    Antennae situated at most slightly below the middle of the compound eyes .... **MYCETOPHILIDAE**
14. Costa continued around the margin of the wings, though weaker behind the apex 17
    Costa ending at or near the apex of the wing.................... 15
15. Wings very broad, the posterior veins weak and poorly developed. **SIMULIIDAE**
    Wings narrow and long, the posterior veins stronger.................... 16
16. Wings lying flat over the back when at rest; metanotum short and without a longitudinal groove; femora sometimes swollen. **CERATOPOGONIDAE**
    Wings lying roof-like over the back when at rest; metanotum long and with a median longitudinal groove; legs long and slender. **CHIRONOMIDAE**
17. Wings short and broad, folded roof-like over the body when at rest, usually pointed .... **PSYCHODIDAE**
    Wings long, or if broad, the apex very broadly rounded, always lying flat over the back when at rest.................... 18
18. Venation very much reduced, several of the veins lacking. **CECIDOMYIDAE**
    Venation not reduced, the veins strong 19
19. Basal cells long, extending to or beyond the middle of the wing.... 20
    Basal cells, especially the second, short, not extending nearly to the middle of the wing.................... **THAUMALEIDAE**

20. Apical veins strongly arched.............................**DIXIDAE**
Veins straight or nearly so..............................**CULICIDAE**
21. Fourth posterior cell widely open....................**ANISOPODIDAE**
Fourth posterior cell closed........................**RACHICERIDAE**
22. Empodium developed pulvilliform, the three pads nearly equal......23
Empodium hair-like or absent......................................29
23. Third antennal segment compound, composed of annuli..............24
Third antennal segment simple, usually bearing an elongated style or arista...27
24. Squamae large and conspicuous ....**TABANIDAE**
Squamae small or vestigial 25
25. At least the middle tibiae with spurs.................**COENOMYIDAE**
Tibial spurs absent...26
26. Posterior branch of the third vein ending before the wing-tip. **STRATIOMYIDAE**
Posterior branch of the third vein ending well behind the wing-tip. **PANTOPHTHALMIDAE**
27. Squamae very large; head very small, placed low down, composed almost entirely of the eyes, the face and front very narrow or obliterated .... **CYRTIDAE**
Squamae small; head larger, the face or front broad...............28
28. Middle tibiae with spurs; venation not complex........**RHAGIONIDAE**
Tibiae without spurs; venation intricate, many veins ending before the wing-tip ....**NEMESTRINIDAE**
29. Wings rounded apically, with strong veins anteriorly and very weak, oblique ones; coxae not widely separated by the sternum.**PHORIDAE**
Wings with normal venation or pointed at the apex, or the coxae broadly separated by the sternum..................................30
30. Wings pointed at the apex, without crossveins ....**LONCHOPTERIDAE**
Wings rounded at the apex almost always with crossveins...........31
31. Two or more submarginal cells, the third vein furcate.............32
Only one submarginal cell, the third vein simple...................38
32. Front hollowed between the eyes, strongly concave from anterior view 33
Front scarcely or not at all concave from anterior view............34
33. At most one ocellus; at most two veins reach the wing margin behind the apex ....**MYDAIDAE**
Three ocelli; at least four veins reach the wing margin, or extend toward it, behind the apex...............................**ASILIDAE**
34. Costa continuing around the wing; fourth vein ending beyond the wing-tip 35
Costa not continued beyond the apex of the wing; fourth vein ending before the wing-tip ....**SCENOPINIDAE**
35. Five posterior cells 36
At most four posterior cells 37
36. Fourth vein ending before the apex of the wing..........**APIOCERIDAE**
Fourth vein ending behind the apex of the wing........**THEREVIDAE**
37. Anal cell open or closed near the wing margin, the anal vein reaching the margin ....**BOMBYLIIDAE**
Anal cell closed far from the wing margin, the anal vein never extending to the margin, sometimes absent ....**EMPIDAE**
38. Anal cell elongate, tapering and acute apically, closed near the border of the wing; basal cells usually elongate.........................39
Anal cell short, transverse, oblique, or convex apically, if somewhat pointed the apex partly transverse, partly drawn out into a triangular point posteriorly...40
39. Anal cell closed very close to the wing margin; a spurious vein running obliquely between the third and fourth longitudinal veins. **SYRPHIDAE**
Anal cell usually shorter; no spurious vein.......................40

40. Head extremely large, hemispherical, the front and face very narrow; arista dorsal .... PIPUNCULIDAE
Head not unusually large; face or front usually wide 41
41. Frontal lunule entirely absent, the parafacials not differentiated by a suture 42
Frontal lunule present; parafacials differentiated by a suture which extends above the antennae and is indistinct only in some Conopidae .. 44
42. Anterior crossvein situated at or before the basal fourth of the wing; second basal and discal cells always united .... DOLICHOPIDAE
Anterior crossvein situated far beyond the basal fourth of the wing or the second basal cell complete 43
43. Anal cell pointed posteriorly; proboscis never rigid and adapted for piercing .... PLATYPEZIDAE
Anal cell not pointed posteriorly; proboscis usually rigid; never a single row of acrostical hairs .... EMPIDAE
44. Coxae close together at the base, the legs attached ventrally 45
Coxae widely separated at the base, the legs attached toward the sides of the thorax; usually leathery or coriaceous flies; ectoparasites (Pupipara) 92
45. Second antennal segment with a longitudinal seam along the upper outer edge extending almost the whole length; posterior calli definitely formed by a depression extending from behind the base of the wings to above the base of the scutellum (Calypteratae; Muscoidea) .. 86
Second antennal segment rarely with a well developed dorsal seam, the posterior calli not differentiated (except in Gasterophilus); squamae small (Acalypteratae) 46
46. Mouth parts vestigial, sunken in a very small oral pit. GASTEROPHILIDAE
Mouth parts well developed, the oral opening large 47
47. Posterior spiracle with a long hair or bristle on the border in addition to the pubescence, (visible only with high magnification) 52
Posterior spiracle with pubescence only 48
48. Arista entirely absent; subcostal vein complete though weak; small flies .... CRYPTOCHAETIDAE
Arista present 49
49. First and second veins ending very close together before the basal third of the wing; anal cell absent or incomplete .... ASTEIIDAE
Second vein always elongate and ending far beyond the first 50
50. Subcosta complete, free from the first vein and ending in the costa (cf. Trupaneidae) 65
Subcosta incomplete, or not ending in the costa or the apex curved forward beyond the bend 51
51. Subcosta curved forward at nearly a right angle and weakened beyond the bend, the costa fractured at the apex of the subcosta; wings almost always pictured .... TRUPANEIDAE
Subcosta not angularly curved and weakened 53
52. Head broad, flattened above; scutellum and thorax flattened, the former elongate; large flies .... ROPALOMERIDAE
Head rather spherical; scutellum usually convex, not elongate; small, cylindrical flies .... SEPSIDAE
53. First segment of the posterior tarsi shortened and incrassate. BORBORIDAE
First segment of the posterior tarsi normal, usually longer than the second 54
54. Anal cell absent 55
Anal cell present 57
55. Postocellar bristles divergent .... EPHYDRIDAE
Postocellars convergent or absent 56

56. Ocellar triangle large; fifth vein with a distinct curvature near the middle of the discal cell .... **CHLOROPIDAE**
Ocellar triangle small; fifth vein straight or without a sharp curvature. **DROSOPHILIDAE**
57. Costa broken at the humeral crossvein..............................58
Costa not broken at the humeral crossvein..........................60
58. Postocellars divergent.................................**AGROMYZIDAE**
Postocellars convergent, parallel or absent........................59
59. A pair of convergent frontal bristles anteriorly; interfrontals often present .... **PHYLLOMYZIDAE**
Anterior frontals not convergent ....**DROSOPHILIDAE**
60. Postocellar bristles convergent ....**OPOMYZIDAE**
Postocellar bristles divergent or absent............................61
61. Ocellar triangle large and shining, reaching the anterior edge of the front .... **CANACEIDAE**
Ocellar triangle short 62
62. Costa fractured or weakened at the apex of the auxiliary vein........63
Costa not at all weakened ....**PERISCELLIDAE**
63. Oral vibrissae present ....**AGROMYZIDAE**
Oral vibrissae absent 64
64. Sternopleural bristle present .... **OPOMYZIDAE**
Sternopleural bristle absent .... **PSILIDAE**
65. Oral vibrissae present 66
Oral vibrissae absent 72
66. Mesonotum and scutellum convex, if rather flattened the abdomen and legs not bristly 67
Mesonotum and scutellum flattened; legs and abdomen conspicuously bristly .... **COELOPIDAE**
67. Postvertical bristles divergent 69
Postvertical bristles convergent 68
68. Orbital plates bearing the frontal bristles short and oblique. **HELOMYZIDAE**
Orbital plates long, extending to the anterior margin of the front or almost so.. **CHYROMYIDAE**
69. Second basal and discal cells separated............................70
Second basal and discal cells confluent.............**DROSOPHILIDAE**
70. Anterior half of the front with strong bristles, two to four pairs present on the front; third antennal segment short and rather orbicular, the arista subapical.................................**CLUSIIDAE**
At most two pairs of rather weak frontal bristles situated on the posterior half; arista sub-basal 71
71. Eyes round; occiput convex and prominent..............**PIOPHILIDAE**
Eyes, vertical, elongate; occiput concave; antennae long. **LONCHAEIDAE**
72. Legs long and slender, stilt-like; apical cell narrowed..............73
Legs shorter and more robust, if rather long the apical cell not strongly narrowed 76
73. Propleura haired 74
Propleura bare in the middle 75
74. Pteropleura haired on whole surface ....**TANYPEZIDAE**
Pteropleura bare on anterior half; second basal cell confluent with the discal .... **MICROPEZIDAE**
75. Arista apical .... **NERIIDAE**
Arista dorsal .... **CALOBATIDAE**
76. Apical cell closed or almost so in the wing margin; abdomen cylindrical, the genitalia usually large......................... **CONOPIDAE**
Apical cell not strongly narrowed or the abdomen short and broad....77
77. Some or all of the tibiae with preapical dorsal bristle...............78
Tibiae without preapical bristle 81

78. Postocellar bristles parallel, divergent or absent....................79
Postocellar bristles convergent ....LAUXANIIDAE
79. Clypeus never prominent; femora with bristles......................80
Clypeus very prominent; femora without bristles......DRYOMYZIDAE
80. Ovipositor flat and wide; front long and moderately narrow; head short, hemispherical, the antennae never porrect; shining blackish flies .... LONCHAEIDAE
Ovipositor not prominent; front wide; head more or less orbicular or the front produced; antennae usually porrect; very rarely shining black .... TETANOCERIDAE
81. Antennae situated on the eye-stalks or at their base........DIOPSIDAE
Antennae situated on the front, though widely separated, regardless of the presence of eye-stalks 82
82. Ocelli absent .... PYRGOTIDAE
Ocelli present 83
83. Postocellar bristles convergent or absent 84
Postocellar bristles divergent or parallel 85
84. Posterior femora swollen and spinose beneath; abdomen clavate; small, slender flies ..............................MEGAMERINIDAE
Posterior femora not swollen and spinose; abdomen short and rather broad, never clavate ...........................CHAMAEMYIDAE
85. Presutural dorsocentrals absent or the subcostal and first veins end far apart .... OTITIDAE
Presutural dorsocentrals present or the thorax bearing very long, fine pile .... PALLOPTERIDAE
86. Metascutellum developed, appearing as a strong convexity below the scutellum; hypopleura with strong bristles ....TACHINIDAE
Metascutellum weak or absent, or if developed there is only hair on the hypopleura 87
87. Oral opening and mouth parts very small; hypopleura with abundant long hair 88
Oral opening normal; hypopleura with a row of bristles or only short, sparse hair 89
88. Scutellum extending far beyond the base of the metanotum; metascutellum never developed .... CUTEREBRIDAE
Scutellum very short; metascutellum usually strongly developed; palpi usually large ....OESTRIDAE
89. Hypopleura with a row of bristles...............................90
Hypopleura with fine, short hair or bare..........................91
90. Apical cell strongly narrowed apically ....METOPIIDAE
Apical cell not at all narrowed apically ....MUSCIDAE
91. Oral vibrissae absent; mesonotum without bristles except above the wings .... PSILIDAE
Oral vibrissae present; mesonotum with bristles...........MUSCIDAE

PUPIPARA AND FLIES WITHOUT OR WITH ABORTED WINGS

92. Coxae widely separated by the sternum; usually parasitic on warm blooded animals 93
Coxae approximate basally; not parasitic on warm blooded animals (except Streblidae) 96
93. Mesonotum short, resembling the abdominal segments; antennae inserted in lateral grooves ....BRAULIDAE
Mesonotum and abdomen differentiated.............................94
94. Head small and narrow, folding back into a groove on the mesonotum; prosternum produced ............................NYCTERIBIIDAE
Head not folding back in a special groove; prosternum not produced..95
95. Palpi broader than long; wings uniformly veined........STREBLIDAE
Palpi elongate, forming a sheath for the proboscis; wing veins crowded anteriorly, weak or absent posteriorly..........HIPPOBOSCIDAE

96. Antennae and mouth parts present 97
Antennae and mouth parts absent ....**STREBLIDAE**
97. Antennae consisting of six or more freely articulated segments......98
Antennae consisting of at most three freely articulated segments..104
98. Mesonotum without a complete, V-shaped suture 99
Mesonotum with a complete V-shaped suture ....**TIPULIDAE**
99. Eyes meeting over the antennae 100
Eyes widely separated above the antennae 102
100. Abdomen enormously swollen, the apical four segments slender; termite guests ....**CECIDOMYIDAE**
Abdomen normal 101
101. Scutellum and halteres present ....**SCATOPSIDAE**
Scutellum and halteres absent ....**SCIARIDAE**
102. Termite guests; ocelli absent; wings with several veins. **PSYCHODIDAE**
Not termite guests 103
103. Halteres present ....**CHIRONOMIDAE**
Halteres absent ....**MYCETOPHILIDAE**
104. Antennae apparently consisting of one more or less globular segment; posterior femora robust and laterally compressed..........**PHORIDAE**
Antennae with two or three quite evident segments; posterior femora not laterally compressed 105
105. Frontal lunule present 106
Frontal lunule absent ....**EMPIDAE**
106. First segment of the posterior tarsi short and swollen....**BORBORIDAE**
First segment of the posterior tarsi longer than the second segment and not swollen 107
107. Arista with long, sparse rays ....**DROSOPHILIDAE**
Arista pubescent or bare; third antennal segment orbicular; wings mutilated by the fly................................**HELOMYZIDAE**

Family TANYDERIDAE

by Charles P. Alexander, Ph. D.
Massachusetts State College

1927. Tanyderidae. Alexander, Genera Insectorum, Fasc. 189: 1 - 13, pl.

Antennae with from 15 to 25 segments, 16 in the local species. Eyes densely short-hairy; no ocelli. Laterocervical plate large to very large. Pronotum massive; metanotum reduced. Tibiae with spurs. Wings (Fig. 18) with five branches of Radius, the forks of *Rs* dichotomous; cell *1st* M_2 closed, elongate; a single developed Anal vein; anal angle prominent. Hypopygium with a single dististyle, bifid in the local species. Ovipositor with short, fleshy valves.

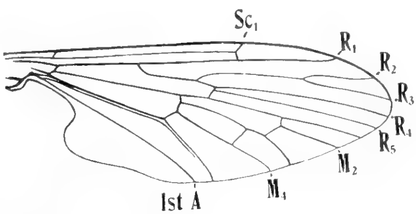

Figure 18. *Protoplasa fitchii* (O. S.); venation.
Symbols: *A*, Anal; *M*, Media; *R*, Radius; *Sc*, Subcosta.

Protoplasa Osten Sacken

1859. *Protoplasa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 252.
1878. *Idioplasta* Osten Sacken; Cat. Dipt. No. Amer., p. 222.

As now restricted (Alexander, Annot. Zool. Japonenses, 13: 275; 1932), the genus *Protoplasa* includes only the single species discussed herewith. It is readily told from the other genera of the family by the presence of a supernumerary cross vein in cell M_3 of the wings (Fig. 18).

Protoplasa fitchii O. S. (Fig. 18).
1859. *Protoplasa fitchii* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 252.

Figs. — Osten Sacken, Mon. Dipt. N. Amer., 4: 317, fig. 7 (ven.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 15, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1: 862, fig. A (ven.), pl. 30, fig. 1 (wing); 1919. Alexander, Gen. Insect., Fasc. 189, Tanyderidae, fig. 11 (ven.), fig. 14C (hyp.); 1927. Comstock, Introd. Ent., p. 796, fig. (ven.); 1924. Crampton, Ann. Ent. Soc. Amer., 18, pl. 1, fig. 7 (thorax); 1925. Crampton, Ent. News, 37, pl. 3, fig. 4 (thorax); 1926. MacGillivray, Extern. Insect Anat., p. 323, fig. 47 (ven.); 1923. Williams, Journ. N. Y. Ent. Soc., 41: 1-35, pls. 1-3 (detailed morphology of both sexes), pl. 6, fig. 33 (wing); 1933.

General coloration grayish brown, the praescutum with four very poorly indicated darker stripes, the intermediate pair narrowly separated. Legs yellow, the femoral tips, tibial bases and tips, tips of basitarsi and all remaining tarsal segments dark brown. Wings (Fig. 18) broad, the anal angle very conspicuous; whitish subhyaline, handsomely cross-banded with brown, with pale spots in centers of bands at origin of *Rs*, along elements of cord, fork of R_{2+3}, outer end of cell *1st* M_2, supernumerary crossvein in cell M_3 and as marginal spots near ends of longitudinal veins. Abdomen brown, with caudal borders of tergites restrictedly pale. ♂. L. 7 - 8.5 mm.; w. 8 - 10 mm. ♀. L. 7 - 8 mm.; w. 10 - 11 mm.

(June, July) Que., N. H., Mass., N. Y., Md., N. C., S. C., Ga., nw. Fla. (Canadian, Transition).

The species is local in distribution but is more abundant and widely distributed than was formerly believed. Its recent discovery in numbers in eastern Canada has been discussed by Crampton (Can. Ent., 61:70-72; 1929) and Alexander (*Ibid.*, 63:137; 1931). Still more recently Dr. Henry Townes, Jr., has discovered it in some numbers in the mountains of South Carolina and Prof. J. Speed Rogers in northwestern Florida.

The immature stages occur in wet sandy soil at margins of major streams, indicating an aquatic or nearly aquatic habitat. The very remarkable immature stages have been described and figured in detail [Alexander, Proc. Linn. Soc. New South Wales, 55:221-230, 2 pls. (larva, pupa); 1930. Crampton, Bull. Brooklyn Ent. Soc., 25:239-258, pls. 15 - 18 (larva); 1930. Crampton, Proc. Ent. Soc. Washington, 32: 83 - 98, pls. 3 - 5 (pupa); 1930]. The adult flies may be swept from rank herbaceous vegetation and low shrubbery near the margins of large streams and small rivers (Alexander, Ent. News, 21: 254; 1910).

Family PTYCHOPTERIDAE

by Charles P. Alexander, Ph. D.
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1927. Ptychopteridae. Alexander, Genera Insectorum, Fasc. 188: 1 - 12, pl.

Head transverse, closely applied to thorax; maxillary palpi elongate, especially the terminal segment. No ocelli. Antennae with 16 (Ptychopterinae) or 20 (Bittacomorphinae) segments. Mesonotum with transverse suture bent strongly caudad at region of scutum to form a deep loop; praescutum with parallel longitudinal furrows on either side of median area. Prehalteres present. Tibiae with spurs. Wings with Sc_2 lacking; *Rs* short; R_{2+3} running close to R_1; R_{1+2} and R_2 subequal, both short; cell R_4 present; cell M_1 present, Fig. 19, A (Ptychopterinae), or lacking, Fig. 19, B (Bittacomorphinae); distal section of Cu_1 very strongly sinuous; a longitudinal fold in cell

Cu, extending from vein *2nd A* to near the bend in vein Cu_1, most distinct in *Ptychoptera*. Abdomen long and slender, especially in males of Bittacomorphinae. Hypopygium with lobes of tergite and basistyle extended. Ovipositor with cerci compressed, bent slightly dorsad.

Adult flies of members of the two subfamilies are very different in appearance, *Ptychoptera* more resembling a large fungus-gnat than it does a crane-fly. *Bittacomorpha*, commonly called the "Phantom Crane-fly" is very different and is one of the most conspicuous and interesting of all local Diptera. The basitarsi of the legs are dilated and filled with tracheae, by means of which the flies drift in the wind with the long legs extended to catch the breeze (Alexander, Cfls. N. Y., 2:784-785; 1920). The immature stages are aquatic or nearly so, living in decaying vegetable matter in swamps. The remarkable larvae and pupae have been much discussed in literature (Alexander, *Ibid.*, 2:772-787, pls. 14-18, inclusive; 1920).

Key to Subfamilies and Genera

1. Antennae 16-segmented; wings with cell M_1 present (Fig. 19, A), in local species cross-banded with brown; legs not banded black and white. (Ptychopterinae) .... **Ptychoptera**
   Antennae 20-segmented; wings with cell M_1 lacking (Fig. 19, B) without markings; legs banded black and white. (Bittacomorphinae) 2
2. Apex of wing with macrotrichia in cells; basitarsi not dilated. .... **Bittacomorphella**
   Apex of wing without macrotrichia in cells; basitarsi of all legs dilated. ... **Bittacomorpha**

Subfamily Ptychopterinae

Ptychoptera Meigen

1800. *Liriope* Meigen; Nouv. Class. Mouch., p. 14 (nom. nud.).
1803. *Ptychoptera* Meigen; Illiger's Mag., 2:262.
1856. *Ctenoceria* Rondani; Dipt. Ital., Prodr., 1:187.

Ptychoptera rufocincta O. S. (Fig. 19, A).
1824. ? *Ptychoptera quadrifasciata* Say; Long's Exped. St. Peters R., Appendix, p. 359.
1859. *P. rufocincta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:252.

Figs. — Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 19 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 15, fig. 2 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 30, fig. 2 (wing); 1919. Alexander, Gen. Ins., Fasc. 188, fig. 8 (antenna, ♂); 1927. Crampton, Ent. News, 37, pl. 3, fig. 6 (thorax); 1926.

Head and mesonotum black, thoracic pleura chiefly yellow. Flagellum uniform black. Legs yellow, the femoral tips narrowly darkened. Wings subhyaline, costal border more yellowish; disk with four more or less complete crossbands, the first at arculus, the third at cord, the last, usually interrupted, across forks of outer cells; wing-tip with numerous macrotrichia in cells (shown in figure 19, A, by dots). Abdomen black, the basal segments ringed at prox-

inal ends with obscure yellow; subterminal segments uniformly blackened; male hypopygium relatively large. ♂. L. 7-8 mm.; w. 6-8.5 mm.; antenna, about 4.5-5 mm. ♀. L. 7.5-9 mm.; w. 8-8.5 mm.

(May-Sept.) Ont., Que., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Ill. and Mich., southw. to S. C., Ga. and Fla.

Connecticut.—Branford, June 13, 1918 (B. H. W.); Hamden, July 24, 1910 (B. H. W.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norfolk, July 24, 1931 (C. P. A.).

It is virtually certain that Say's name *quadrifasciata* is the prior one for this species but there are some discrepancies in the original description that render it inadvisable to assert the synonymy.

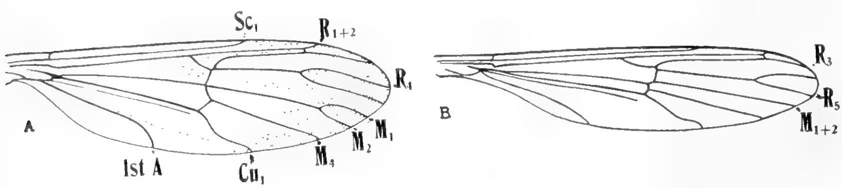

FIGURE 19. Ptychopteridae; venation.
A. *Ptychoptera rufocincta* O.S. B. *Bittacomorpha clavipes* (Fabr.)
Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

Subfamily Bittacomorphinae

Bittacomorphella Alexander

1916. *Bittacomorphella* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 545.

This so-called "pygmy phantom cranefly" is widespread and locally common, usually near springs or small streams in cold woods.

Bittacomorphella jonesi (Johns.)
1905. *Bittacomorpha jonesi* Johnson; Psyche, 12: 75-76.
1916. *Bittacomorphella jonesi* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 545.

Figs.—Alexander, Cfls. N. Y., 1, pl. 30, fig. 4 (wing); 1919. Alexander, Gen. Ins., 188, fig. 1 (ad. ♂), fig. 7 (antenna, ♂), fig. 14 (wing); 1927.

Antennae unusually long. Mesonotum black; head, lateral praescutum, thoracic pleura and median region of scutum silvery pruinose; scutellum and mediotergite chiefly pale. Legs banded with snowy white, including a broad band on basal third of all tibiae and all of tarsal segments two and three, together with the extreme tip of

basitarsus and extreme base of fourth segment. Abdomen elongate. ♂. L. 8 - 10 mm.; w. 6.5 - 7 mm.; antenna, 6 - 6.5 mm. ♀. L. 9 - 10 mm.; w. 7 - 8 mm.

(May-early Sept.) N. B., Me., N. H., Vt., Mass., R. I., N. Y., Pa., westw. to Mich., southw. to Va., N. C., and S. C. (Canadian).

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); Riverton, July 23, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.).

Bittacomorpha Westwood

1835. *Bittacomorpha* Westwood; London & Edinburgh Phil. Mag., 6:281.

The common "phantom cranefly" may be easily recognized by the black and white banded legs and conspicuously swollen basitarsi. The adults are very characteristic of swales, sloughs and similar swampy areas, in the rich organic mud of which the early stages may be found.

Bittacomorpha clavipes (Fabr.) (Fig. 19, B).
1781. *Tipula clavipes* Fabricius; Spec. Ins., 2: 404.
1805. *Ptychoptera clavipes* Fabricius; Syst. Antl., p. 22.
1835. *Bittacomorpha clavipes* Westwood; *ibid.*, 6:281.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 20 (wing); pl. 4, fig. 31 (hyp.); 1869. Westwood, Trans. Ent. Soc. London, 1881, pl. 19, fig. 12 (ven., head); 1881. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 10, figs. 35-39 (hyp.); 1904. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 15, fig. 3 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3, p. 84, fig. 25, sub. 12 (ven.); 1908. Alexander, Cfls. N. Y., 1:862, fig. B (ven.); pl. 30, fig. 3 (wing); 1919. Crampton, Trans. Amer. Ent. Soc., 48, pl. 10, fig. 32 (hyp.); 1923. Alexander, Gen. Ins., 188, fig. 9 (leg); fig. 15 (wing); 1927. Crampton, Ent. News, 37, pl. 3, fig. 6 (thorax); 1926. Cole, Proc. Calif. Acad. Sci. (4) 16:461, figs. 14, 17 (hyp.); 1927. Crampton, Journ. N. Y. Ent. Soc., 39, pl. 20 (basal abdom. segs.); 1931. Dickinson, Cfls. Wisc., p. 174, fig. 44 (ven.); 1932.

Antennae relatively long. Color of mesonotum black, the posterior sclerites silvery; praescutum with a capillary median line of this color. Pleura silvery. Legs black, banded with white, the latter including narrow rings on basal fourth of tibiae, proximal fourth of basitarsi, and all of tarsal segments two and three. ♂. L. 10 - 14 mm.; w. 5.5 - 8 mm.; antenna, about 4.5 - 5 mm. ♀. L. 12 - 15 mm.; w. 8 - 9 mm.

(May-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Man., Col. and Utah, southw. to S. C., Ga., Tenn. and Fla.

Connecticut.—Branford, Aug. 24, 1904 (P. L. B.); E. Conn., May 13-Sept. 6 (C. W. J.); E. Hartland, Sept. 11, 1928 (C. P. A.); E. Rock Park, New Haven, May 20, 1904 (B. H. W.); Granby, June 8, 1929 (C. P. A.); New Haven, Aug. 20, 1928 (G. B.); Norfolk, Sept. 12, 1928 (C. P. A.); Salisbury, Sept. 12, 1928 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Storrs, May 1929 (H. W. C.); Twin Lakes, Sept. 12, 1928 (C. P. A.); Waterbury, May 28, 1908 (W. E. B.); W. Granby, Sept. 11, 1928 (C. P. A.); Woodmont, July 10, 1904 (P. L. B.).

Family TRICHOCERIDAE

by CHARLES P. ALEXANDER, PH. D.
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1928. Trichoceridae. Edwards, Genera Insectorum, Fasc. 190: 30-37.

Antennae 16-segmented, the flagellum elongate, setaceous, with outer segmentation obscure. Labrum reduced. Ocelli three. Praescutum without pseudosutural foveae; a distinct V-shaped suture between praescutum and scutum; scutum flat, not separated from scutellum by a suture. Legs long and slender but not breaking readily as in the Tipulidae; basitarsi (in local genera) elongate; tibial spurs present. Wings (Fig. 20) with Sc_1 long; cell M_1 always present; *m-cu* lying far distad; vein *2nd A* short and curved in *Trichocera*, more extended in *Diazosma*; anterior arculus almost lost by atrophy, shortened by a caudad bend of *R*; squama fringed with setae. Male hypopygium with a single dististyle, this latter usually simple, cylindrical, but sometimes complicated by basal tubercles or processes. Ovipositor with cerci feebly sclerotized or fleshy; when elongate, the curvature downward instead of upward, as normal for the Tipulidae.

The family Trichoceridae includes the well-known "Winter Gnats" or "Winter Crane-flies," not uncommon during the Fall and Spring and likewise occurring out-of-doors on warm days in Winter, flying about in sunlit places where the adults are found in small to larger swarms. The adult flies may also be found in cellars, caverns, mines and similar darkened retreats. The immature stages live in decaying vegetable matter, as beneath rotted leaves, in stored roots and tubers, in fungi, and in similar haunts showing organic decay. The immature stages have been well-discussed in literature (Keilin, Bull. Scient. France et Belgique, (7) 46: 172-191, pls. 5-8; 1912. Alexander, Cfls. N. Y., 2: 789-791, pl. 19; 1920. Rhynehart, Belfast Nat. Hist. & Philosoph. Soc., 102: 1-14, 3 pls.; 1925. Edwards (Keilin), Genera Insectorum, 190: 31-32, pl. 2, figs. 14-18; 1928).

Key to Genera

1. Vein *2nd A* long, subsinuous, not suddenly bent into anal angle of wing; eyes glabrous; ovipositor with ceri very short and fleshy .... **Diazosma**

   Vein *2nd A* short, strongly curved into the anal margin of wing (Fig. 20): eyes with dense setae between the ommatidia; ovipositor with cerci sclerotized, with the curvature downward .... **Trichocera**

Diazosma Bergroth

1880. *Trichoptera* Strobl; Progr. Gymn. Seitenstetten, p. 64 (preoccupied).
1881. *Diazoma* Wallengren; Ent. Tidskr., 2: 180 (preoccupied).
1913. *Diazosma* Bergroth; Ann. Mag. Nat. Hist., (8) 11: 583.

Diazosma subsinuata (Alex.)

1915. *Trichocera* (*Diazosma*) *subsinuata* Alexander; Journ. N. Y. Ent. Soc., 24: 124.

Figs.—Alexander, *Ibid.,* 24, pl. 8, fig. 10 (ven.). Alexander, Cfls. N. Y., 1, pl. 41, fig. 166 (ven.); 1919. Crampton, Ann. Ent. Soc. Amer., 18, pl. 4, fig. 13 (thorax); 1925. Dickinson, Cfls. Wisc., p. 174, fig. 43 (ven.); 1932.

General coloration dark brown, the praescutum without stripes. Halteres and legs brown. Wings strongly infuscated, the veins with long trichia. ♂. L. 7 mm.; w. 9-10 mm. ♀. L. 8-9 mm.; w. 9-11.5 mm.

(June-Aug.; Nov.) Ont, Que., N. B., N. Y., westw. to Wisc., Colo. and Wash. (Hudsonian, high Canadian; in coniferous woods).

Trichocera Meigen

1800. *Petaurista* Meigen; Nouv. Class. Mouches, p. 15 (nom. nud.).
1803. *Trichocera* Meigen; Illiger's Mag., 2: 262.
1924. *Trichocerodes* Brethes; Commun. Mus. Nac. Buenos Aires, 2: 172.

The taxonomy of our local species is still much involved and more work must be done before an accurate idea of synonymy and distribution is obtained. Several species are widely distributed in the North Temperate Zone while others seem to be much more restricted in their range.

Key to Species

1. Wings unmarked except for the stigmal darkening.......... 2
   Wings variously marked with brown, in addition to the stigmal area.......... 3
2. Base of wing somewhat paler than the remainder; male hypopygium with dististyle at base bearing a very small, slender tubercle.......... **saltator**
   Wings not paler at base; male hypopygium unusually complex, the dististyle long and slender, near base bearing a long slender rod that is about one-third the total length of style.......... **salmani**
3. Wings with all veins except the Anals seamed with brown, more distinct at and beyond the cord.......... **venosa**
   Wings without seams on veins beyond cord.......... 4
4. Wings with a dark cloud on anterior cord; no dark spot in cell *R* beneath origin of *Rs*.......... 5
   Wings with a dark spot in cell *R* beneath origin of *Rs,* additional to a darkened cloud on anterior cord.......... 6
5. Wings strongly suffused with dusky; male hypopygium with dististyle bearing a conspicuous ear-like lobe at base.......... **garretti**
   Wings hyaline or nearly so; male hypopygium with dististyle cylindrical, unarmed.......... **regelationis**
6. Femora yellowish, with a subterminal brown ring; wings with a more or less distinct dark cloud in cell R_3.......... 7
   Femora yellowish brown, the tips narrowly darkened; no dark cloud in outer radial field.......... **fernaldi**
7. Abdominal tergites conspicuously dimidiate, their bases pale, the outer half darkened; male hypopygium without tubercle at base of dististyle.......... **bimacula**
   Abdominal tergites uniformly darkened; male hypopygium with a small tubercle on mesal face of dististyle at base.......... **maculipennis**

Trichocera bimacula Wk.

1848. *Trichocera bimacula* Walker; List Dipt. Brit. Mus., 1: 84.
1923. *T. bimacula* Edwards; Ann. Mag. Nat. Hist., (9) 12: 492.

Fig.—Crampton, Ann. Ent. Soc. Amer., 18, pl. 4, fig. 11 (thorax); 1925.

I am interpreting this species in accordance with Edwards' comparison of the type male with *maculipennis*, this implying dark subterminal rings on femora and a darkened cloud in outer radial cells, as in *maculipennis*. The fly differs from both *fernaldi* and *maculipennis* in the dimidiate abdominal tergites. ♂. L. about 5 mm.; w. 5 mm.

(Oct., Nov.) N. S., Me., Mass., Ct., N. Y.

Connecticut.—without closer data (C. W. J.).

Dickinson (Cfls. Wisc., p. 173, fig. 41; 1932) reports this fly from Wisconsin in October. From his figure of the wing it is apparent that there is a mis-determination and the species in question is possibly either *garretti* or *regelationis*.

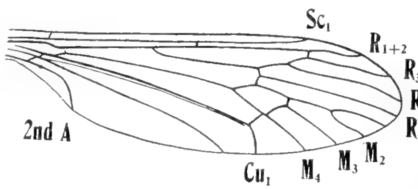


FIGURE 20. *Trichocera garretti* Alex.; venation.
Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

T. fernaldi Alex.
1927. *Trichocera fernaldi* Alexander; Can. Ent., 59: 70-71.

Figs.—Alexander, *Ibid.*, 59: 70, figs. 1, 2 (ven.).

Praescutal stripes four, the lateral pair subobsolete. Knobs of halteres dark brown. Dististyle of male hypopygium without basal tubercle. ♂. L. 4.5-5 mm.; w. 6.5-7 mm.

(Oct., Nov.) Mass., Ct., westw. to Mich.

Connecticut.—New Haven, Oct. 31, 1903 (H.L.V.); Shelton, Nov. 14, 1932 (J.P.J.); Yalesville, Oct. 19, 1903 (H.L.V.).

T. garretti Alex. (Fig. 20).
1927. *Trichocera garretti* Alexander; Can. Ent., 59: 71-72.

Mesonotum brownish black, without markings. Male hypopygium with the basal two-fifths of dististyle enlarged, on mesal face expanded into a flattened ear-like lobe. ♂. L. 4-4.5 mm.; w. 6-6.5 mm.

(Mar.-May) Mass., westw. to B. C.

T. maculipennis Meig.
1818. *Trichocera maculipennis* Meigen; Syst. Beschreib., 1: 214.

Fig.—De Meijere, Tijdschr. v. Ent., 64: 88, fig. 128 (hyp.); 1921.

♂. L. about 6-6.5 mm.; w. 7-8 mm. ♀. L. about 7-7.5 mm.; w. 8-10 mm.

(Apr., May) Que., westw. to Alta. and B. C. (Eurasia).

T. regelationis (Linn.)
1758. *Tipula regelationis* Linnaeus; Syst. Nat., ed. 10: 587.

♂. L. about 4.5-5 mm.; w. 5.5-6 mm.

(Mar.-June; Nov., Dec.) Northern N. Amer. (Eurasia). Reported by Johnson, probably correctly, from Me. and Mass.

Connecticut.—Hamden, April 18, 1930 (R. B. F.).

T. salmani Alex.
1927. *Trichocera salmani* Alexander; Can. Ent., 59: 72-73.

The remarkable male hypopygium is quite unique among the local species. Ninth tergite deeply emarginate, each lobe with a dense brush of long reddish bristles. ♂. L. about 4-4.5 mm.; w. 5-5.5 mm.

(Oct.-Jan.) Mass.; still known only from Amherst.

T. saltator (Harr.)
1782. *Tipula saltator* Harris; Expos. English Ins., p. 57.
1824. ?*Trichocera scutellata* Say; Long's Exped. St. Peters R., Append., p. 360.
1848. ?*Trichocera brumalis* Fitch; Winter Ins. N. Y., p. 9.
1848. *Trichocera gracilis* Walker; List Dipt. Brit. Mus., 1: 84.
1912. *Trichocera montana* Brunetti; Fauna Brit. India, Dipt. Nemat., p. 513.
1924. *Trichocera saltator* Edwards; Ann. Mag. Nat. Hist., (9) 14: 174.

Figs.—Alexander, Cfls. N. Y., 1, pl. 41, fig. 165 (ven.); 1919. Young, Cornell Univ., Agr. Expt. Sta. Mem. 44: 284, pl. 10, fig. 10 (thorax); 1921. Dickinson, Cfls. Wisc., p. 173, fig. 42 (ven.); 1932.

Coloration brownish black, gray pruinose, the praescutum without distinct stripes. ♂. L. about 4 mm.; w. 5-6 mm.

(Apr., May; Sept.-Nov.) Occasional on warm bright days throughout winter. Ont., Que., Me., N. H., Mass., N. Y., westw. to Ind., Mich., Wisc. and Man., southw. to Ga. (Eurasia).

Connecticut.—New Haven, October 21, 1903; Nov. 20 (H. L. V.); Yalesville, Oct. 19, 1903 (H. L. V.).

(This species also includes erroneous North American records for *Trichocera hiemalis* (de Geer), at this time definitely known as Nearctic only from the Far North).

The above synonymy is on the authority of Dr. Edwards and must be assumed to be correct unless very strong proof to the contrary can be produced.

T. venosa Dtz.
1921. *Trichocera venosa* Dietz; Trans. Amer. Ent. Soc., 47: 236.

Considered by Edwards as being possibly only a heavily patterned variety of *maculipennis*. Still known only from the unique type. ♀. L. 6.5 mm.; w. 7 mm.

(Oct.) Pa.

Family ANISOPODIDAE

by CHARLES P. ALEXANDER, PH. D.
Massachusetts State College

1928. Anisopodidae. Edwards, Genera Insectorum, Fasc. 190: 7-26, 2 pls.

Head somewhat flattened, not produced behind. Ocelli three, forming a close equilateral triangle. Fronto-clypeal suture lacking; labrum reduced, membranous. Mesonotal praescutum and scutum not evidently separated by a transverse suture; pleurotergite undivided. Tibial spur-formula 1-2-2; claws simple. Wings with three branches of R reaching margin (Fig. 21, A-C); R_3 preserved as a distinct element in *Axymyia* (Fig. 21, B), uniting with R_{1+2} far distad; Rs straight, oblique, in direct alignment with basal section of R_5; $r\text{-}m$ distinct; cell *1st* M_2 closed (*Anisopus*, Fig. 21, A) or open by atrophy of outer veins; distal section of Cu_1 sinuous (*Anisopus*) or straight; a single preserved Anal vein.

Three diverse groups are here included, the habits being briefly discussed under the subfamily headings.

Key to Subfamilies and Genera

1. Cell *1st* M_2 closed; M with four branches (Fig. 21, A); cells of wing with abundant macrotrichia (Anisopodinae) .... **Anisopus**
   Cell *1st* M_2 open; M with three branches (Fig. 21, B, C); cells of wing without macrotrichia 2
2. Vein R_3 present as a distinct element near tip of R_{1+2}, forming an apical fusion of R_{1+2+3}; $r\text{-}m$ oblique placed at or beyond midlength of M_{1+2}, in cases close to fork of vein; main stem of M preserved (Fig. 21, B) (Axymyinae) .... **Axymyia**
   Vein R_3 atrophied; $r\text{-}m$ transverse, placed far before fork of M_{1+2}; main stem of M chiefly atrophied (Fig. 21, C) (Mycetobiinae) .... **Mycetobia**

Subfamily ANISOPODINAE

Anisopus Meigen

1800. *Phryne* Meigen; Nouv. Class. Mouches, p. 16 (nom. nud.).
1803. *Anisopus* Meigen; Illiger's Mag., 2: 264 (nom. nud.); 1804, Klass., 1: 102.
1805. *Rhyphus* Latreille; Hist. Nat. Crust. Ins., 14: 291.

The immature stages occur in or near decaying organic matter, as in manure and fermenting sap. The early stages have been described and figured in detail (Keilin, Ann. Mag. Nat. Hist., (9) 3, pl. 2, fig. 1; 1919. Edwards, Gen. Ins., 190: 11-12, pl. 2; 1928). The adult males swarm in small to larger groups, mating taking place

when females fly from nearby shrubbery into the swarms. Adults are frequently found resting on windows in houses or resting on tree trunks in the open.

Key to Species

1. Wings with cell M_1 pointed at base, *m* connecting with M_{1+2} at fork; wing-tip clear .... **marginatus**
   Wings with cell M_1 truncated at base, *m* connecting with M_2 some distance beyond base; wing-tip with distinct brown markings, heaviest in radial field 2
2. Pale spot in outer radial field white, clearly delimited; a very small dark spot in cell *R* beneath the fork of *Rs*; median mesonotal stripe divided .. **alternatus**
   Pale spot in outer radial field dirty white or yellowish white, its limits ill-defined; no dark spot in cell *R* beneath the fork of *Rs*; median mesonotal stripe entire .... **fenestralia**

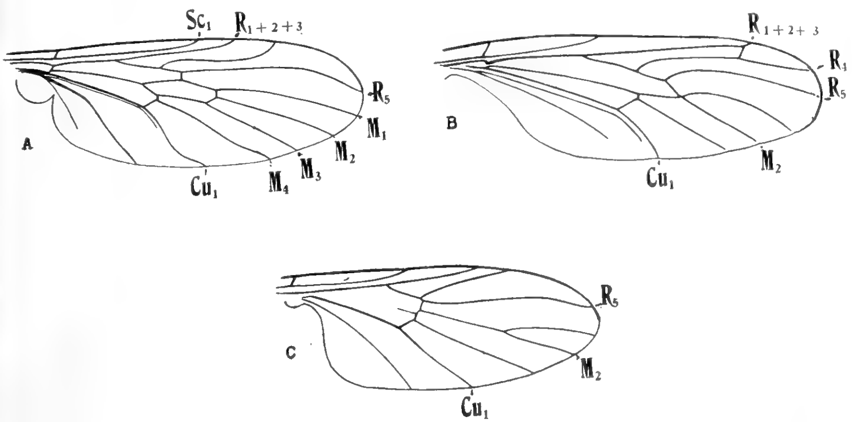


FIGURE 21. Anisopodidae; venation.
A. *Anisopus fenestralis* (Scop.) B. *Axymyia furcata* McAtee
C. *Mycetobia divergens* Walk.
Symbols: *Cu,* Cubitus; *M,* Media; *R,* Radius; *Sc,* Subcosta.

Anisopus alternatus (Say)

1823. *Rhyphus alternatus* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 27.

1918. *R. alternatus* Baerg; Ent. News, 29: 354; Alexander, Cfls. N. Y., 1: 888; 1919.

Figs.—Dickinson, Cfls. Wisc., p. 152, fig. 29 (head), p. 172, fig. 39 (wing); 1932.

♂ ♀. L. 4-4.5 mm.; w. 5.5-6 mm.

(Apr.-June; Sept.) Ont., Que., Me., N. H., Mass., R. I., N. Y., N. J., Pa., westw. to Wisc. and Kan.

Connecticut.—Branford, June 27, 1904 (H. L. V.); New Haven, March 28, 1925 (G. M. F.), May 25, 1919 (W. E. B.), July 1, 1928 (W. E. B.); Orange, pupae in slime mold, June 8, 1920, emerged June 12-14 (M. P. Z.); Stamford, Apr. 4, 1929 (B. T. R. L.).

A. fenestralis (Scop.) (Fig. 21, A).
1763. *Tipula fenestralis* Scopoli; Ent. Carniol., p. 322.
1923. *Anisopus fenestralis* Edwards; Ann. Mag. Nat. Hist., (9) 12: 476.
1923. *A. diversipes* Fitch, in Edwards; *Ibid.*, (9) 12: 476.

Fig.—Edwards, *Ibid.*, (9) 12: 477, fig. i (hyp.).

♂ ♀. L. 5 mm.; w. 6 mm.

(Mar.-Oct.) Ont., Que., Me., N. H., Mass., R. I., N. Y., N. J., Pa.; also in Europe.

Connecticut.—Branford, July 3, 1905 (H. W. W.); E. Windsor, (W. F. B.); Madison, Aug., 26, 1904 (H. L. V.); New Canaan, Oct. 10, 1903 (B. H. W.); New Haven, May 30, 1910 (W. E. B.).

A. marginatus (Say)
1823. *Rhyphus marginatus* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 27 (includes all North American records of *punctatus*, nec *punctatus* Fabricius; vide Edwards, Ann. Mag. Nat. Hist., (9) 12: 488; 1923. Gen. Ins., 190: 17; 1928).

Figs.—Edwards, Ann. Mag. Nat. Hist., (9) 12:477, fig. m (hyp.); 1923. Crampton, Proc. Ent. Soc. Washington, 27, pl. 7, fig. 20 (labium); 1925. Cole, Proc. Calif. Acad. Sci., (4) 16: 461, figs. 16, 18 (hyp.); 1927. Dickinson, Cfls. Wisc., p. 172, fig. 40 (wing); 1932.

(Apr.-May; Aug.-Nov.) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., Va., westw. to Ill. and Wisc.

Connecticut.—New Haven, May 7, 1911 (B.H.W.); Orange, June 22, 1904 (H.L.V.); Salisbury, Aug. 27, 1904 (W. E. B.).

Subfamily Axymyinae

1921. Axymyinae; Shannon, Proc. Ent. Soc. Washington, 23: 50-51.

A single known genus and species, placed by Edwards (Gen. Ins., 190: 27-29; 1928) in the family Pachyneuridae. The general appearance and essential characters seem to me to fall more within the limits of the Anisopodidae where it was first assigned by Shannon.

Axymyia McAtee

1921. *Axymyia* McAtee; Proc. Ent. Soc. Washington, 23: 49.

Antennae 16-segmented; flagellar segments broader than long. Eyes (♂) large, contiguous, composed of an upper area of larger ommatidia and a lower area of smaller ones, without a definite separation between the two: eyes of female dichoptic. Setae of body very reduced or lacking. Thorax and abdomen short and stout, the mesonotum gibbous. Tibiae without spurs. Wings (Fig. 21, B) with macrotrichia on veins C, R, R_1, Rs; on basal section of R_5 and basal fourth of outer section of R_5 with trichia present but very small; tips of all branches of M and *1st A* evanescent; setae of anal fringe small and inconspicuous.

Axymyia furcata McAtee. (Fig. 21, B).
1921. *Axymyia furcata* McAtee; Proc. Ent. Soc. Washington, 23: 49.

Figs.—Coquillett, Ent. News, 20: 106, fig. (ven.); 1909. Crampton, Ann. Ent. Soc. Amer., 18, pl. 4, fig. 14 (thorax); 1925. Edwards, Gen. Ins., 190, pl. 1, fig. 9 (ven.); 1928.

General coloration dark brown. Wings strongly suffused with brown, more saturated on costal third; wing-base faintly yellowish; a whitish spot in cell R above fork of Rs. ♀. L. 5-6 mm.; w. 6-7 mm.

(Apr., May) Mass., N. Y., Pa., Va. (Canadian, high Transition).

The occurrence of this very uncommon fly in New England has been discussed by the writer (Occas. Pap. Boston Soc. Nat. Hist., 5: 115; 1924). Only two specimens have yet been taken in New England, both on Mount Toby, near Amherst, Mass., where they were swept from low herbage along a mountain stream.

Subfamily Mycetobiinae

General appearance much like a fungus-gnat, Mycetophilidae, with which group it was long associated.

Eyes finely pubescent, only narrowly separated on vertex. No definite ocellar tubercle. Maxillary palpi 3-segmented. Praescutal and scutal setae well-developed; scutellum with four marginal setae. No macrotrichia on wing-membrane; well-developed and strong on all of the non-evanescent veins; C extending to some distance beyond tip of R_5. The following veins are faint and tend to become evanescent: Base of Sc, branches of M and extreme outer end of the main stem of M, outer half of Cu_1 and A; the basal portion of the main stem of M, together with Cu_2, are quite atrophied. R and all of its branches, together with Cu, are well-preserved and provided with numerous macrotrichia.

Mycetobia Meigen

1818. *Mycetobia* Meigen; Syst. Beschr., 1: 229.
1861. *Mycetoica* Rondani; Prodr. Dipt. Ital., 4, Corrig., : 12.

The larvae live in the fermenting sap of trees, in decaying wood, and in similar places showing organic decay, where they are sometimes associated with the larvae of *Anisopus*. The immature stages have been discussed in detail by Johannsen (Maine Agr. Expt. Sta. Bull. 177: 31-32, figs. 38-43; 1910), Keilin (Ann. Mag. Nat. Hist., (9) 3: 33-35, pl. 2, fig. 2; 1919) and Edwards (Gen. Ins., 190: 24, pl. 2, figs. 6-9; 1928). The adult flies occur on tree trunks near exuding sap and more rarely may be found on windows in houses.

Mycetobia divergens Wk. (Fig. 21, C).
1856. *Mycetobia divergens* Walker; Ins. Saund., Dipt., p. 418.
1867. *Mycetophila persicae* Riley; Prairie Farmer, 35: 397.
1869. *Mycetobia sordida* Packard; Guide Study Insects, p. 388.
1903. *M. marginalis* Adams; Kan. Univ. Sci. Bull., 2: 21.

Figs.—Johannsen, Maine Agr. Expt. Sta. Bull. 172, fig. 77 (ven.); 1909. Alexander, Cfls. N. Y., 1: 889, fig. B (ven.); 1919. Crampton, Ann. Ent. Soc. Amer., 18, pl. 5, fig. 20 (thorax); 1925. Cole, Proc. Calif. Acad. Sci., (4) 16: 463, fig. 34 (hyp.); 1927.

Head black: palpi yellow at tips. Antennae black. Mesonotum and pleura shiny black, the humeri, lateral margins of notum and scutellum more tinged with reddish. Legs yellow, the outer tarsal segments darkened. Wings hyaline. Abdomen yellow basally, the outer segments darkened. ♂ ♀. L. 3-4 mm.; w. 3-4 mm.

(July) Me., Mass., N. Y., westw. to Mo. and Col.

Connecticut.—Hartford (C. W. J.).

Family TIPULIDAE

by Charles P. Alexander, Ph. D.
Massachusetts State College

1926. Tipulidae, Tipulinae. Pierre, Genera Insectorum, Fasc. 186: 1-68, 5 pls.

1927. Tipulidae, Cylindrotominae. Alexander, *Ibid.*, Fasc. 187: 1-16, 2 pls.

Date? Tipulidae, Limoniinae. Alexander, *Ibid.* (in preparation).

Antennae with from 5 to 39 segments, in local species with not more than 19, commonly 13 (Tipulinae, most Pediciini); 14 (most Limoniini); 16 (most Hexatomini and Eriopterini); form of antennae various, from moniliform and setaceous to serrate and pectinate (males of *Limonia*, subgenus *Rhipidia*; *Ctenophora*; *Tanyptera*: Figs. 25, A, B; 34, F, G). Maxillary palpi with from one to four segments, commonly the latter. Labial palpi reduced, at most 2-segmented. Frontal prolongation of head in most Tipulinae bearing a small "*nasus*" or nose at apex of dorsal surface; in cases, the mouth parts are produced into a slender rostrum that exceeds in length one-half the entire body, this either comprised of a long, slender prolongation of the front, with the reduced mouth parts at extreme tip (*Elephantomyia*, Fig. 46, L; *Toxorhina*) or else made up chiefly of greatly elongated labial palpi (*Limonia*, subgenus *Geranomyia*, Fig. 34, C). Eyes glabrous, rarely (Pediciini) short-hairy; eyes usually of moderate size, separated above by the wide anterior vertex, the latter sometimes reduced or lacking, producing a holoptic condition (males of *Limonia* species). No ocelli. Posterior sclerites of head sometimes produced and narrowed behind.

Pronotum usually well developed. Thoracic dorsum comprised chiefly of the mesonotum, with well-developed praescutum (lying before the so-called V-shaped or transverse suture, Fig. 22, D), scutum, scutellum, and postnotum, the latter with a median (mediotergite) and lateral (pleurotergites) subdivisions. Praescutum often with paired double dots (*tuberculate pits*) near cephalic end, or with a polished impressed humeral area (*pseudosutural foveae*) on either

side; ground-areas (*interspaces*) between the usual praescutal stripes usually with abundant setae. Pleural sutures distinct; pleural sclerites glabrous or variously provided with setae. Halteres long to very long. Legs breaking readily at junction of trochanter and femur; tibiae with or without spurs at distal end; five tarsal segments; claws smooth or variously toothed near base (*Tipula; Limonia*, Fig. 34, D, E); legs almost invariably long and slender, shortest and stoutest in nearly apterous species, as *Chionea*. Wings (Fig. 23) with from one to three branches of *Rs*; two to four branches of *M*; Cu_2 present (in local species), lying close behind Cu_1, longest in most Tipulinae where it virtually attains the margin; two Anal veins (in all local species); in most members of the family an enclosed discal (*1st* M_2) cell; radial crossvein, *r*, lacking, as in all Diptera, but its position taken and simulated by the transversely placed R_2; wings almost invariably with strong setae (*macrotrichia*) on certain of the veins; more rarely with these in the cells (best developed in *Ula*, *Ulomorpha* and *Ormosia*).

Abdomen always long and slender, sometimes (*Longurio*, *Tipula longiventris*, female) excessively so; apex of abdomen in males enlarged into a club-shaped hypopygium (Fig. 22, B, C); females usually with an elongate, acutely pointed ovipositor, comprised of slender, gently upcurved dorsal valves (*cerci*) and shorter, more nearly straight sternal valves (*hypovalvae*). Male hypopygium comprised of basistyles (parameres, coxites, pleurites, gonostipes or side-pieces), bearing at their tips the more or less complicated dististyles (styles, claspers, apical appendages); a complex armature surrounding the aedeagus, the most evident structures being the gonapophyses (parameres, genital palpi), the whole structure sometimes fused into a complex mass, the phallosome. Dorsal surface of basistyle at proximal end (as in *Epiphragma*, Fig. 22, C) with a sclerotized rod, the interbase, lost in all more specialized types. Anal tube dorsal in position. Lateral angles of ninth tergite often produced into slender lobes or spines (as in Tipulinae, *Dolichopeza;* Pediciini, *Dicranota;* Limoniini, *Dicranoptycha*).

Morphological References. In addition to the features above listed, certain other details of body structure and wing venation are shown in Figs. 22 and 23. The detailed account of dipterous morphology given by Doctor Crampton earlier in this volume will prove of the very greatest value in determining doubtful structures. Numerous papers are now available discussing the various morphological features throughout the Order. For convenience of reference. I have listed a number of the more important papers that pertain to the Tipulidae.

HEAD AND MOUTH PARTS.

Crampton, G. C.
1917 A phylogenetic study of the larval and adult head in Neuroptera, Mecoptera, Diptera and Trichoptera.
Ann. Ent. Soc. Amer., 10: 337-344, figs. 1-14.
1921 The sclerites of the head, and the mouth-parts of certain immature and adult insects.
Ibid., 14: 65-110, pls. 2-8.

FIGURE 22. Tipulidae; structures.

A. *Tipula (Yamatotipula) jacobus* Alex.; lateral aspect of head and thorax, showing principal structures.

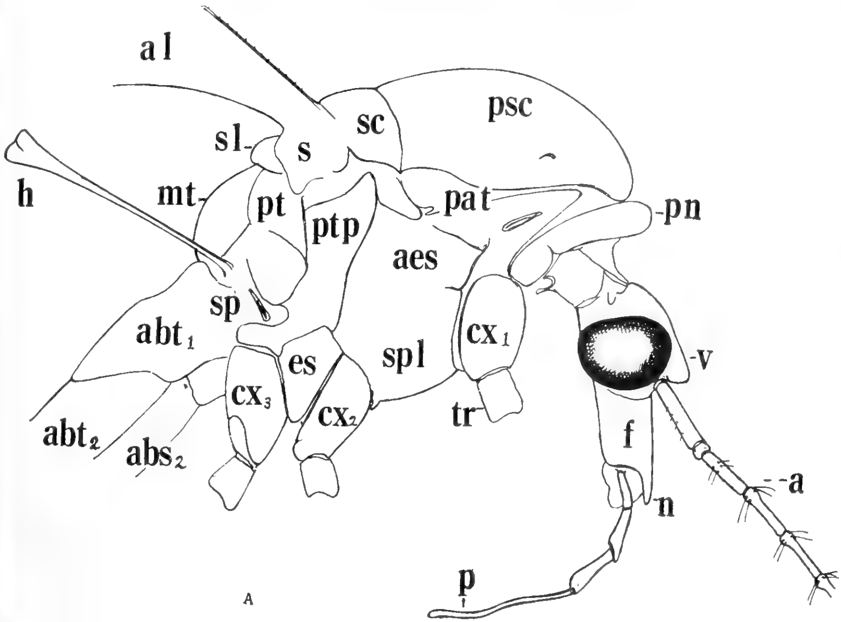
B. The same; apex of abdomen of male, showing hypopygium, lateral aspect.

C. *Epiphragma (Epiphragma) fascipennis* (Say); male hypopygium, dorsal aspect.

D. *Pseudolimnophila inornata* (O.S.); mesonotum, dorsal aspect.

Symbols:

a antenna
abs abdominal sternites
abt abdominal tergites
aed aedeagus
aes anepisternum (mesepisternum)
al wing
b basistyle (coxite, pleurite, gonostipes, side-piece)
cx coxa
d dististyle (style, clasper, apical appendage)
em epimeron
es episternum
f frontal prolongation of head (rostrum)
h haltere
in interbase
mt postnotal mediotergite
n nasus
p maxillary palpus
pas parascutellum
pat pretergite (paratergite)
pf pseudosutural fovea (humeral pit)
pn pronotum
psc praescutum
pt postnotal pleurotergite
ptp pteropleurite (mesepimeron)
s squama
sc scutum
sl scutellum
sp spiracle
spl sternopleurite (mesepisternal katepisternum)
tp tuberculate pit (double dots)
tr trochanter
v vertex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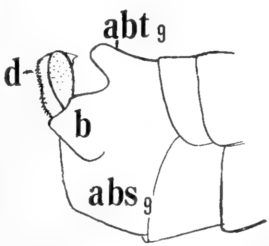
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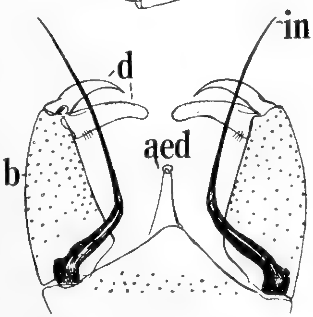
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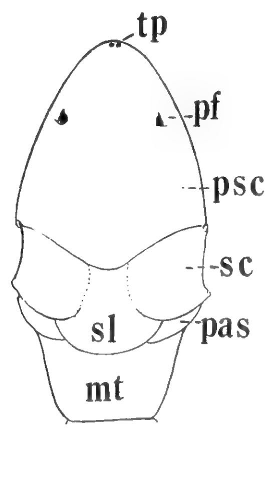
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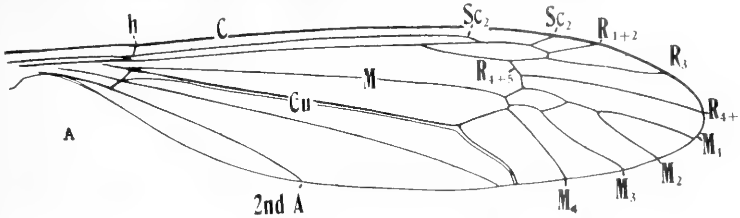
FIGURE 23. Venation of chief tribes and subfamilies of Tipulidae.

A.	*Tipula* (*Yamatotipula*) *tricolor* Fabr.	(TIPULINAE)
B.	*Limonia* (*Limonia*) *triocellata* (O.S.)	(LIMONIINI)
C.	*Dicranota (Eudicranota) pallida* Alex.	(PEDICIINI)
D.	*Pseudolimnophila inornata* (O.S.)	(HEXATOMINI)
E.	*Ormosia monticola* (O.S.)	(ERIOPTERINI)

(Interpreted according to the Comstock-Needham System, as modified for the Radial field by Alexander and for the Cubital field by Tillyard.)

Symbols:

A	Anal veins	*m*	medial crossvein
C	Costa	*m-cu*	medial-cubital crossvein
Cu	Cubitus	*R*	Radius
h	humeral crossvein	*Rs*	Radial sector
M	Media	*Sc*	Subcosta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C
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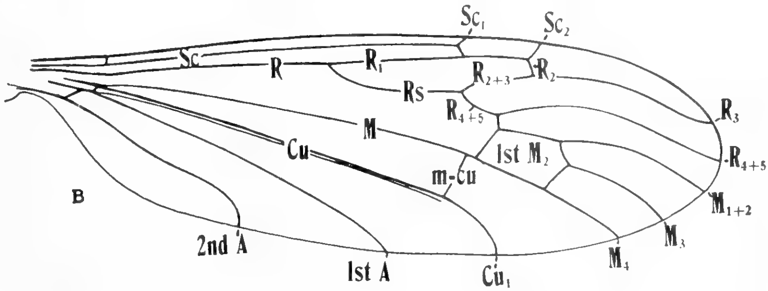
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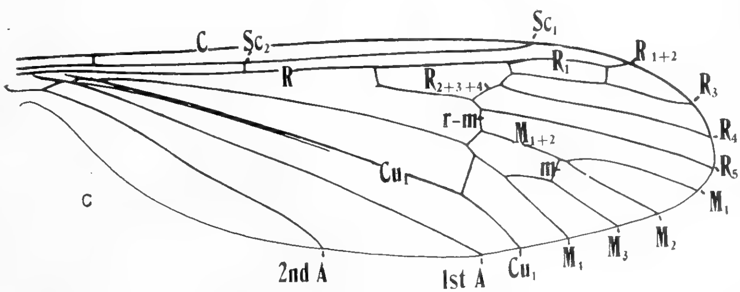
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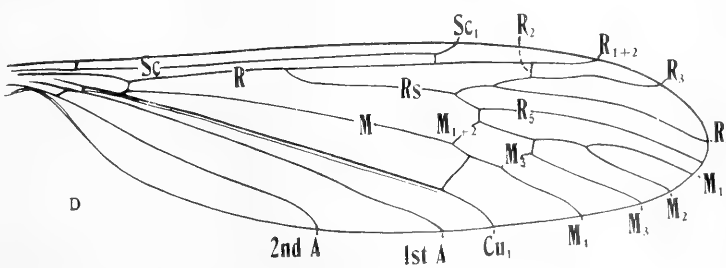
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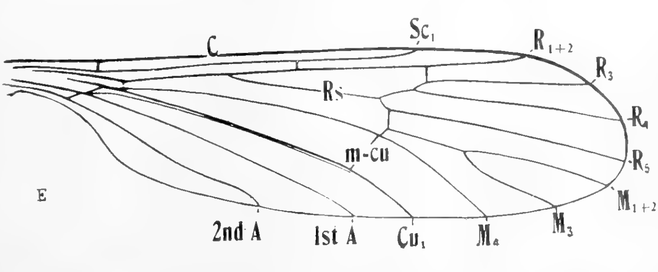
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2nd A
1st A
Cu1
M4
M3
E

1923 A phylogenetic comparison of the maxillae throughout the orders of insects.
Journ. N. Y. Ent. Soc., 31: 77-107, pls. 12-17.
1925 A phylogenetic study of the labium of holometabolous insects, with particular reference to the Diptera.
Proc. Ent. Soc. Washington, 27: 68-91, pls. 6-8.

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1916 The head-capsule and mouth-parts of Diptera.
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THORACIC SCLERITES, WING-BASES AND LEGS.

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Can. Ent., 55: 126-132, pl. 3.
1925a A phylogenetic study of the thoracic sclerites of the non-Tipuloid Nematocerous Diptera.
Ann. Ent. Soc. Amer., 18: 49-74, pls. 1-5.
1925b Evidences of relationship indicated by the thoracic sclerites of certain Eriopterine Tipuloid Diptera.
Insec. Inscit. Menst., 13: 197-213, pls. 2-3.
1926a A phylogenetic study of the thoracic sclerites of the Psychodoid Diptera, with remarks on the inter-relationships of the Nematocera.
Ent. News, 37: 33-39, 65-70, pls. 3-4.
1926b A comparison of the neck and prothoracic sclerites throughout the orders of insects from the standpoint of phylogeny.
Trans. Amer. Ent. Soc., 52: 199-248, pls. 10-17.

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1909 The thorax of insects and the articulation of the wings.
Proc. U. S. Nat. Mus., 36: 511-595, pls. 40-69.

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1921 Attachment of the abdomen to the thorax in Diptera.
Cornell Univ. Agr. Expt. Sta., Mem. 44: 255-306, 76 figs.

VENATION.

Alexander, C. P.
1927 The interpretation of the radial field of the wing in the Nematocerous Diptera, with special reference to the Tipulidae.
Proc. Linn. Soc. New South Wales, 52: 42-72, 92 figs.
1929 A comparison of the systems of nomenclature that have been applied to the radial field of the wing in the Diptera.
IV. Internat. Congress Ent., 2: 700-707, 3 pls.
1934 (In C. H. Curran, The families and genera of North American Diptera, pp. 38-39, figs.)

Comstock, J. H.
1918 The Wings of Insects, pp. 1-430, 427 figs., 10 pls.

MacGillivray, A. D.
1923 The anal veins in the wings of Diptera.
Ent. News, 34: 106-111.

Needham, J. G.
1908 Venation of the wings of Tipulidae.
23rd Rept. N. Y. St. Ent. for 1907: 217-238, pls. 11-32, figs. 11-16.

Tillyard, R. J.
1919 The Panorpoid Complex. Part 3.—The wing-venation.
Proc. Linn. Soc. New South Wales, 44: 533-718, pls. 31-35, figs. 35-112.

GENITALIA.

Cole, F. R.
1927 A study of the terminal abdominal structures of male Diptera (Two-winged Flies).
Proc. California Acad. Sci., (4) 16: 397-499, figs. 1-287.

Crampton, G. C.
1923 The genitalia of male Diptera and Mecoptera compared with those of related insects, from the standpoint of phylogeny.
Trans. Amer. Ent. Soc., 48: 207-225, pls. 8-10.
1941 The terminal abdominal structures of male Diptera.
Psyche 48: 79-94, 2 pls.

Snodgrass, R. E.
1903 The terminal abdominal segments of female Tipulidae.
Journ. N. Y. Ent. Soc., 11: 177-183, pls. 10-11.
1904 The hypopygium of the Tipulidae.
Trans. Amer. Ent. Soc., 30: 179-236, pls. 8-18.

The Tipulidae, commonly called "Crane-flies", comprises one of the largest families of Diptera, with some 8,500 described species, of which nearly 500 occur in northeastern North America. The adult flies frequent a variety of habitats, though usually not far from moisture, required in one form or another by the larvae of all species. The habitats of the immature stages have been briefly discussed under the various genera. Students who are interested in the early stages of these flies are referred to the following papers:

Alexander, C. P.
1920 The crane-flies of New York. Part II. Biology and Phylogeny.
Cornell Univ. Agr. Expt. Sta., Mem. 38: 691-1133, pls. 11-97 (Bibliography of immature stages to 1920).
1931 The crane-flies (Tipulidae, Diptera). Deutsche Limnologische Sunda-Expedition.
Archiv für Hydrobiol., Suppl. Bd. 9, Tropische Binnengewässer, Bd. 2, pt. 36: 135-191, 2 pls. (Bibliography of immature stages 1920-1930. Summary of larval habitats of Tipulidae).

Rogers, J. S.
1926 Notes on the biology and immature stages of *Gonomyia* (*Leiponeura*) *pleuralis* (Will.). Tipulidae, Diptera.
Florida Ent., 10: 33-38, 5 figs.
1927a Notes on the life history, distribution and ecology of *Diotrepha mirabilis* Osten Sacken.
Ann. Ent. Soc. Amer., 20: 23-36, 9 figs.
1927b Notes on the biology of *Atarba picticornis* Osten Sacken. Tipulidae-Diptera.
Florida Ent., 10: 49-55, 7 figs.
1927c Notes on the biology and immature stages of *Geranomyia* (Tipulidae, Dipt.) 1. *Geranomyia rostrata*.
Ibid., 11: 17-26, 7 figs.
1930 The summer cranefly fauna of the Cumberland plateau in Tennessee.
Occas. Papers Mus. Zool. Univ. Michigan, 215: 1-50, 5 pls.
1932 On the biology of *Limonia* (*Dicranomyia*) *floridana* (Osten Sacken).
Florida Ent., 15: 65-70, 8 figs.
1933a The ecological distribution of the crane-flies of northern Florida.
Ecol. Mon. 3, no. 1: 1-74, figs. 1-25.
1933b Contributions toward a knowledge of the natural history and immature stages of the crane-flies. 1. The genus *Polymera* Wiedemann.
Occas. Papers Mus. Zool. Univ. Michigan, 268: 1-13, 2 pls.

Geographical Limits. The area adopted in the present report is almost that considered in Gray's "New Manual of Botany", seventh edition, 1908, that is, northeastern North America, north to the 50th degree of north Latitude, west to the 96th Meridian. The southern limits include the south boundary lines of Kansas, Missouri, Kentucky and Virginia. It is believed that this northeastern area includes about all of the species that are regional to Connecticut and to the adjoining states of Massachusetts, Rhode Island and New York. A very few extra-limital species have been included while undescribed species still continue to be discovered within the area. The present list for Connecticut includes 229 species. To this figure may be added 120 species that have been taken in either Massachusetts or New York, or both, virtually all of which may well be taken in Connecticut as a result of further collecting. The remaining species treated herein occur elsewhere in New England and southern Canada, or in New Jersey and Pennsylvania, southward and westward. Following each species is given a brief summary of range by states and provinces, with particular reference to the occurrence of species in the New England States and New York, the western and southern limits being indicated by the marginal states attained. These states and provinces are abbreviated in accordance with standard symbols. Following certain of the species, the life-zone or zones to which it is restricted is given in parentheses. In Connecticut, three life-zones are found, the Canadian, the Transition (Alleghenian) and the Upper Austral (Carolinian).

Regional Lists. Our knowledge of crane-fly distribution has been built up through intensive collecting and study over a period of many years. The following papers are of the greatest importance in studying the area under present consideration.

Ontario.

Alexander, C. P.

1926 Records of crane-flies from Ontario.
Can. Ent., 58: 236-240. (77)

1928 The same, Part II.
Ibid., 60: 54-60. (159)

Quebec.

Alexander, C. P.

1929 A list of the crane-flies of Quebec, I.
Ibid., 61: 231-236, 247-251. (139)

1931 The same, Part II.
Ibid., 63: 135-147. (208)

Winn, A. F., and Beaulieu, G. (as revised by Petch, C. E. and Maltais, J. B.)

1932 A preliminary list of the insects of the province of Quebec. Part 2, Diptera.
Quebec Soc. Prot. Plants, 24: 5-100. (246)

New England.

Johnson, C. W.

1925 Diptera of New England.
Occas. Papers Boston Soc. Nat. Hist., 7, no. 15: 1-326. (264)

Alexander, C. P.
1925 First supplementary list of Tipulidae.
Ibid., 5: 169-174. (277)
1927 Second supplementary list.
Ibid., 5: 223-231. (290)
1930 Third supplementary list.
Ibid., 5: 267-278. (318)
1936 Fourth supplementary list.
Ibid., 8: 273-292. (346)
Proctor, William
1938 Biological survey of the Mount Desert Region. Part VI. The insect fauna with references to methods of capture, food plants, the flora and other biological features, pp. 496, 12 figs., 1 map. (198)

New York.
Alexander, C. P.
1919 The crane-flies of New York, Part I.
Cornell Univ. Agr. Expt. Sta., Mem. 25: 765-993. (267)
1922 First supplementary list.
Bull. Brooklyn Ent. Soc., 17: 58-62. (277)
1924 Second supplementary list.
Ibid., 19: 57-64. (282)
1929 Third supplementary list.
Ibid., 24: 22-29. (306)
1929 Fourth supplementary list.
Ibid., 24: 295-302. (318)

Michigan.
Rogers, J. Speed
1942 The crane-flies (Tipulidae) of the George Reserve, Mich.
Mus. Zool., Univ. Mich., Misc. Publ. 53: 1-128, 8 pls., 1 map. (206)

Wisconsin.
Dickinson, W. E.
1932 The crane-flies of Wisconsin. (130)
Bull. Public Mus. Milwaukee, 8: 139-266, Frontis., pls. 22-24, figs. 29-197 (abbreviated in this paper, Cfls. Wisc.).

The figures in parentheses following each of the above references represent the consecutive totals in number of species of Tipulidae from the area in question.

For much information, still unpublished, regarding the range of various species elsewhere in the region under consideration, I wish to express my deepest thanks to Professor J. Speed Rogers (for records from Michigan, Iowa, Indiana, Tennessee, North Carolina, Georgia and Florida) and to Dr. Henry Townes, Jr. (North Carolina, South Carolina).

Seasonal Limits. Crane-flies are wonderfully restricted in their season of flight-appearance. The seasonal range given in parentheses at the end of each species is that for Connecticut, or for that state or province nearest Connecticut where the species is known to occur. This restriction of dates is of particular importance in the case of wide-ranging species, which might be found on the wing in May in Connecticut, in April in the latitude of Washington, and even as early as February or March in the southern part of the range of the species in question. Most Tipulidae are on the wing only for a

month or so, but some have a more extended flight period. In some species this is due to their having two generations per season, the first appearing in Spring or early Summer, the second in late Summer or Autumn.

Figures. The figures herein supplied have been chosen from a wealth of material. The wing venation of each genus and subgenus is illustrated, together with that of certain other species that deviate in important regards from the genotype. Where such species have macrotrichia in the wing-cells, these are indicated by circular dots to represent the position of the setigerous punctures. No attempt has been made to show the wing pattern, eminently characteristic of many species with variegated wings. For the local species, most of these have been shown in an earlier report by the writer (The Crane-flies of New York, Part I, Cornell Univ. Agr. Expt. Sta. Mem. 25:765-993, text-figs. 121-132, pls. 30-55; 1919, abbreviated in this report as "Cfls. N. Y., 1"), which should be used in conjunction with the present paper. For further convenience of reference, all other readily available figures have been cited, in conjunction with the various species. The figures cited, with those supplied as original at this time, should aid materially in the identification of these flies.

Special emphasis is here placed on the structure of the male hypopygium, which furnishes almost the sole available specific characters in many groups. Such figures are somewhat diagrammatic outlines to show details and position of parts. Mounts for preserving the genitalic structures are easily made in the following manner: The apex of the abdomen is removed and placed in cold KOH, 10 percent solution, overnight. After thorough washing, dehydration and clearing in xylol, permanent slide mounts may be made in dammar or balsam.

Connecticut Collections and Acknowledgments

The records of Tipulidae for the State List have been derived from a variety of sources. One of the largest single series is that of the Connecticut Agricultural Experiment Station, amassed during a long period of years by the various members of the staff, under the leadership of Doctor Britton, and indicated in this report by the collector's initials. A second major series is that of the University of Connecticut (Connecticut State College), collected by Professors de Coursey and Manter, together with their various students in entomology. Most of these latter records are indicated by the initials, C. S. C. (Connecticut State College).

The numerous records secured by the late Mr. Charles W. Johnson and collaborators (Occas. Papers Boston Soc. Nat. Hist., 7:1-326; 1925) have been included. A small collection from near Avon was taken by Dr. C. H. Curran. The majority of the specimens discussed herewith have been taken by Dr. G. C. Crampton, Mrs. Alexander, and myself during the course of many trips into the State during the years 1928 to 1933. One notable excursion made by us (June 8-9,

1929) added no fewer than 68 species of Tipulidae to the list as then known. Special attention has been devoted to Litchfield County, including a systematic month by month survey of the rich fauna of Kent Falls and vicinity.

Especial thanks are extended to Dr. Britton and to Dr. Friend for their kindly advice and cooperation during the progress of this study.

Abbreviations: Besides the standard State abbreviations, a few others are given throughout the text in order to save space. These are as follows:

abdom.—abdominal	southw.—southward
e.—east, eastern	southwestw.—southwestward
eastw.—eastward	ven.—venation
hyp.—male hypopygium	w.—west, western
l.—body length	westw.—westward
n.—north, northern	w.—wing length
northw.—northward	♂—male sex
northwestw.—northwestward	♀—female sex
s.—south, southern	

Key to Subfamilies

1. Terminal segment of maxillary palpus elongate, whiplash-like; nasus usually distinct; antennae usually with 13 segments; wings (Fig. 24) with Sc_1 usually atrophied; vein Cu_1 constricted at *m-cu,* the latter usually at or close to the fork of M_{3+4}; body-size large.......................... **Tipulinae**
   Terminal segment of maxillary palpus short; no distinct nasus; antennae usually with either 14 or 16 segments; Sc_1 present, the tip atrophied in some Cylindrotominae (Fig. 33); vein Cu_1 straight, not constricted at *m-cu,* the latter placed far before the fork of M_{3+4}, usually at or close to fork of M; body-size usually small or medium........................ 2
2. Wings with tip of R_{1+2} atrophied, giving the appearance of a long fusion back from the margin of veins R_1 and the anterior branch of its sector; free tip of Sc_2 preserved (Fig. 33, E-I).................... **Cylindrotominae**
   Wings sometimes with tip of R_{1+2} atrophied (Limoniini, Fig. 34, A, B) but not giving the appearance of a long fusion back from the margin of veins R_1 and the anterior branch of the sector; free tip of Sc_2 preserved in many species of Limoniini (Fig. 34, A, B), lacking in all other tribes in this fauna (Figs. 38, 40, 43, 44, 47, 50)........................ **Limoniinae** 297

The only subapterous crane-flies within our faunal limits are members of the genus *Chionea* (Eriopterini) and the female sex of some species of *Pedicia* (Pediciini), both belonging to the subfamily Limoniinae.

Subfamily Tipulinae

In the local fauna, the Tipulinae include almost all of the larger species of Tipulidae. Most of the included forms have an average size greater than that of the other major subfamily, the Limoniinae. Exceptions in the latter group occur in rare instances, as certain species of *Limonia*, *Limnophila*, *Eriocera*, and *Pedicia*.

Key to Subtribes, Genera and Subgenera

1. Legs unusually long and filiform; wings with vein R_{1+2} atrophied and with Sc_2 ending in Sc close to origin of Rs (*Dolichopeza*, Figs. 24, A, B); or R_{1+2} preserved, Sc very long and Sc_1 reaching C as a distinct element some distance beyond fork of Rs; *r-m* shortened or obliterated by fusion of adjoining veins (*Brachypremna*, Fig. 24, C)........... (DOLICHOPEZARIA) 2

   Legs of normal stoutness for the family; wings (Fig. 24, D-H) with vein R_{1+2} preserved; when latter is atrophied (a few species of *Tipula*), with *r-m* disinct, Sc of moderate length, Sc_1 atrophied before fork of Rs and with Sc_2 ending at or near midlength of Rs (exception, some *Longurio*, which never have white on legs, as is the case in *Brachypremna*)......... 3

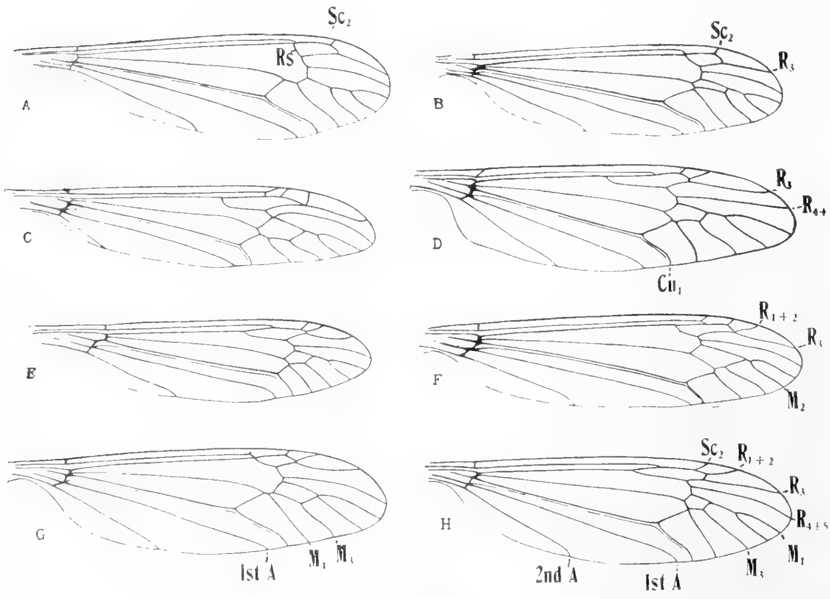


FIGURE 24. Tipulinae; venation.

A. *Dolichopeza (Dolichopeza) americana* Ndm.
B. *D. (Oropeza) similis* (Johns.)
C. *Brachypremna dispellens* (Wk.)
D. *Ctenophora angustipennis* Lw.
E. *Prionocera fuscipennis* (Lw.)
F. *Longurio testaceus* Lw.
G. *Nephrotoma ferruginea* (Fabr.)
H. *Tipula (Lunatipula) bicornis* Forbes

Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

2. Wings with R_{1+2} atrophied; Rs short, transverse, simulating a cross vein, about equal in length to one-half *m-cu* (Fig. 24, A, B).......... **Dolichopeza**

   Wings with R_{1+2} pale, perpendicular to R_{2+3}; Rs strongly arcuated at origin (Fig. 24, C).. **Brachypremna**

3. Antennal flagellum of male branched (Fig. 25, A, B), of female branched or serrate; flagellar verticils present but short; legs relatively short and stout. .... (CTENOPHORARIA) 4

   Antennal flagellum simple (serrate in *Prionocera*; Fig. 25, C), which is readily told by lack of antennal verticils); legs usually more slender...... (TIPULARIA) 5

4. Antennae (♂) with three pectinations on each of flagellar segments 2 to 9, each segment with a single branch on apical half, in addition to the usual basal pair (Fig. 25, A); ovipositor greatly elongated, sabre-like .... **Tanyptera**
   Antennae (♂) with two pairs of pectinations on each of flagellar segments 2 to 9, one pair being subbasal, the other subapical (Fig. 25, B); ovipositor short and of normal tipuline structure .... **Ctenophora**
5. Flagellar segments without verticils, the lower face of individual segments slightly produced near outer end, giving the organ a serrate appearance; terminal flagellar segment abruptly more slender (Fig. 25, C) .... **Prionocera**
   Flagellar segments verticillate, simple or nearly so 6
6. Abdomen of both sexes greatly elongated, somewhat resembling that of a dragonfly; verticils of outer flagellar segments very long and conspicuous; cerci of ovipositor with smooth margins .... **Longurio**
   Abdomen not so elongated (except in ♀ of *Tipula longiventris* which has cerci serrate on outer margins); antennal verticils of moderate length only. 7
7. Wings (Fig. 24, G) with *Rs* short and oblique in position, shorter than *m-cu*; cell M_1 sessile or very short-petiolate; vein M_4 arising opposite or basad of origin of M_{1+2}; body-coloration highly polished, often black and yellow. .... **Nephrotoma**
   Wings (Fig. 24, H) with *Rs* elongate, exceeding *m-cu;* cell M_1 petiolate; vein M_4 arising distad of origin of M_{1+2}; body-coloration almost always opaque, pruinose or pollinose (polished only in *nobilis* and a few allies). **Tipula**

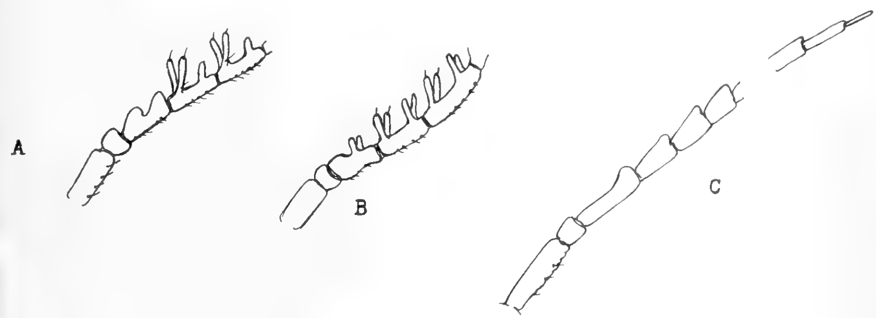


FIGURE 25. Tipulinae; details of antennae.
A. *Tanyptera frontalis* (O.S.); ♂, basal five segments.
B. *Ctenophora apicata* O.S.; ♂, basal five segments.
C. *Prinocera dimidiata* (Lw.); ♂, in part, intermediate flagellar segments omitted.

Dolichopeza Curtis

1825. *Dolichopeza* Curtis; Brit. Ent., p. 62.

An extensive genus of flies, with representatives in all major regions. The reasons for uniting *Dolichopeza* and *Oropeza* into a single genus have been given in another report (Alexander, Philippine Journ. Sci., 46:269-270; 1931).

The venation of the radial field is quite like that of the genus *Limonia*, except that no species of *Dolichopeza* is known where the

free tip of Sc_2 is carried distad of the level of R_2, as is common in the Limoniini. Most of the species in our region are very similar in general appearance and are most readily separated by characters of the male hypopygium.

The adults are among the best-known of local flies, being found in small dancing groups in darkened shady places, as in shaded spots in woods, beneath culverts and bridges, in outhouses, in crannies and caverns of shaded cliffs, beneath overhanging boulders, in the shade of uprooted shallow tree roots, and numerous other similar situations. When not engaged in a characteristic vertical dance, they hang from the roof of their haunts by the fore legs, the posterior pair hanging pendant. The larvae live in moss cushions, often in dry situations.

Key to Subgenera

1. Wings with cell *1st* M_2 open by atrophy of basal section of vein M_3 (Fig. 24, A). .... **Dolichopeza: Dolichopeza**
   Wings with cell *1st* M_2 closed (Fig. 24, B) .... **Dolichopeza: Oropeza**

Subgenus **Dolichopeza** Curtis

Dolichopeza (*Dolichopeza*) **americana** Ndm. (Fig. 24, A).
1908. *Dolichopeza americana* Needham; 23rd Rept. N. Y. St. Ent. for 1907: 211.

Figs.—Needham, *Ibid.*, pl. 16, fig. 5 (ven.). Alexander, Cfls. N. Y., 1, pl. 43. fig. 187 (wing); 1919.

Praescutum with three brown stripes, the lateral pair and areas on scutal lobes darker. Pleura yellow, variegated with brown area. Legs brown, the tips of basitarsi and all succeeding tarsal segments snowy white. ♂. L. 8-9 mm.; w. 10-10.5 mm. ♀. L. 8.5-9 mm.; w. 9.5-10 mm.

(June, July) Labr., Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., Ohio, Ind., Mich., southw. to Tenn., S. C. and Ga.

Connecticut.—E. Hartland, June 8, 1929 (C. P. A.); Hartford, June 12, 1931 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12 - 13, 1931 (C. P. A.); Norfolk, June 9, 1929 (G. C. C.); Riverton, June 12, 1931 (C. P. A.); Tunxis State Park, June 12, 1931 (C. P. A.); Union, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (G. C. C.).

Subgenus **Oropeza** Needham

1908. *Oropeza* Needham; 23rd Rept. N. Y. St. Ent. for 1907: 211.

Key to Species (*based on male characters*)

1. Tarsi snowy white 2
   Tarsi dark brown, brown or yellowish 3
2. Male hypopygium with the outer dististyle shorter than the inner dististyle; gonapophysis appearing as a flattened blade provided with delicate setulae, the apex an acute glabrous point. (Fig. 26, A) .... **carolus**
   Male hypopygium with the outer dististyle longer than the inner; gonapophyses appearing as divergent lobes that are set with abundant blackened spines and setae. (Fig. 26, H) .... **subalbipes**

3. Halteres pale yellow, without conspicuously darkened knobs (slightly suffused at bases of knobs in *sayi* and *walleyi*); male hypopygium with gonapophyses more or less expanded outwardly into pale blades, usually with pale spinous points.. 4
   Knobs of halteres dark brown; male hypopygium with gonapophyses either appearing as divergent cushions set with black spinous points, or else as flattened blades that narrow at apex into a single acute spine......... 6
4. Aedeagus at apex split into two acute black points; each gonapophysis at apex extended laterad into a long point. (Fig. 26, G)................**similis**
   Aedeagus simple; gonapophysis not prolonged into a slender apical point... 5
5. Gonapophyses not spinose, appearing as flattened blades that are slightly expanded at outer ends, the surface with abundant setulae. (Fig. 26, F) **sayi**
   Gonapophyses expanded at tips, the apex set with irregular denticles. (Fig. 26, K)..**walleyi**
6. Gonapophyses appearing as flattened plates, without spines.............. 7
   Gonapophyses appearing as divergent cushions, set with strong black spines and spinous setae. 8
7. Thoracic pleura yellow, unmarked; stigma pale brown; no dark seam along vein *Cu*; hypopygium with lateral arms of tergite not expanded; gonapophyses not blackened at tips. (Fig. 26, B)..................**dorsalis**
   Thoracic pleura variegated with dark brown; stigma dark brown; a dark seam along vein *Cu*; hypopygium with lateral arms of tergite angularly expanded; gonapophyses gradually narrowed into long black spines. (Fig. 26, J) ....**venosa**
8. Median region of 9th tergite of male hypopygium more or less produced. 9
   Median region of 9th tergite of male hypopygium weakly emarginate. (Fig. 26, C)..**johnsonella**
9. Surface of thoracic notum usually subnitidous; male hypopygium with base of outer dististyle abruptly dilated. (Fig. 26, E)....................**polita**
   Surface of thoracic notum opaque male hypopygium with the outer dististyle not expanded at base 10
10. Median region of tergite of male hypopygium produced into a small, dark plate that is tridentate at apex; inner dististyle very broad, bidentate and spinous at tip. (Fig. 26, I)...........................**tridenticulata**
    Median region of tergite produced into a small point on either side of median line; inner dististyle narrow, at apex narrowed to an obtuse blackened point. (Fig. 26, D)...................................**obscura**

Arrangement of species, based on male hypopygial characters:

1. Gonapophyses (Fig. 26, C, D, E, H, I) densely set with blackened spinous setae. **johnsonella, obscura, polita, subalbipes, tridenticulata.**
2. Gonapophyses (Fig. 26, A, B, F, G, J, K) appearing as flattened plates, with setae, but no blackened spines or spinous setae, the apex smooth or else terminating in one or more glabrous pale spines. **carolus, dorsalis, sayi, similis, venosa, walleyi.**

Dolichopeza (*Oropeza*) **carolus** nom. nov. (Fig. 26, A).
1909. *Oropeza albipes* Johnson; Proc. Boston Soc. Nat. Hist., 34:121 (preoccupied).

Fig.—Johnson, *Ibid.*, pl. 15, fig. 12 (hyp.).

Praescutum brown, with three darker stripes; pleura yellow, variegated with dark brown. Knobs of halteres darkened. Male hypopygium (Fig. 26, A). ♂. L. 10 mm.; w. 12 mm. ♀. L. 12 - 13 mm.; w. 11 - 12 mm.

(June-Aug.) Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ind. and Mich., southw. to Va., N. C., S. C. and Tenn.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C.P.A.); Granby, July 9, 1929 (R. B. F.); Kent Falls, July 23-24, 1931 (C. P. A.); Norfolk, July 24, 1931 (C. P. A.); N. Woodstock, June 30, 1928 (C. F. C.); Riverton, July 23, 1931 (C. P. A.): Salisbury, Sept. 12, 1928 (C. P. A.); Tunxis State Park, July 23, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

This preoccupied species is re-named in honor of the late Mr. Charles W. Johnson, whose friendly interest was largely responsible for leading me into a study of the Tipulidae.

D. (*Oropeza*) **dorsalis** (Johns.) (Fig. 26, B).
1909. *Oropeza dorsalis* Johnson; *Ibid.*, 34:119-120.

Fig.—Johnson, *Ibid.*, pl. 15, fig. 6 (hyp.).

General coloration yellow, the mesonotum brown, including scutellum and center of mediotergite; praescutal stripes confluent, with a delicate darker median line. Tarsi brown or brownish black. Male hypopygium (Fig. 26, B): gonapophyses much as in *carolus*, densely setiferous, the acute apex glabrous. ♂. L. 9 - 10 mm.; w. 9 - 10 mm. ♀. L. 10.5 - 11 mm.; w. 9 - 10 mm.

(June) Ont., Que., Me., N. Y., westw. to Mich. and Alta., southw. to Md. and N. C. (Hudsonian, Canadian).

Connecticut.—East River, July 14, 1912 (Ely) 1 ♂.

D. (*Oropeza*) **dorsalis rogersi** (Alex.)
1922. *Oropeza rogersi* Alexander; Occas. Papers Mus. Zool. University Michigan, 127:6-7.

Almost identical with the typical form but smaller; hypopygium identical. ♂. L. 7.5 - 8.3 mm.; w. 8.5 - 9 mm. ♀. L. 10 mm.; w. 9 mm.

(May, June) Va., southw. to Ind. and nw. Fla. (Transition, Austral).

D. (*Oropeza*) **johnsonella** (Alex.) (Fig. 26, C).
1930. *Oropeza johnsonella* Alexander; Bull. Brooklyn Ent. Soc., 25:279-280.

Mesonotum reddish brown, the praescutal stripes darker but relatively indistinct. Halteres dusky. Tarsi paler than remainder of legs, yellowish brown. Male hypopygium (Fig. 26, C): lateral arms of tergite long, slender. ♂. L. 8 - 9 mm.; w. 9.8 - 11 mm.

(Aug.) N. J., southw. to S. C. (Transition, Austral).

D. (*Oropeza*) **obscura** (Johns.) (Fig. 26, D).
1909. *Oropeza obscura* Johnson; Proc. Boston Soc. Nat. Hist., 34:122.

Figs.—Johnson, *Ibid.*, pl. 15, fig. 7 (ven.), fig. 10 (hyp.). Alexander, Cfls. N. Y., 1, pl. 43, fig. 186 (wing); 1919. Dickinson, Cfls. Wisc., p. 212, fig. 114 (wing); 1932.

Mesonotum opaque dark brown, pleura almost uniform dull brown. Antennae (♂) relatively long, if bent backward extending

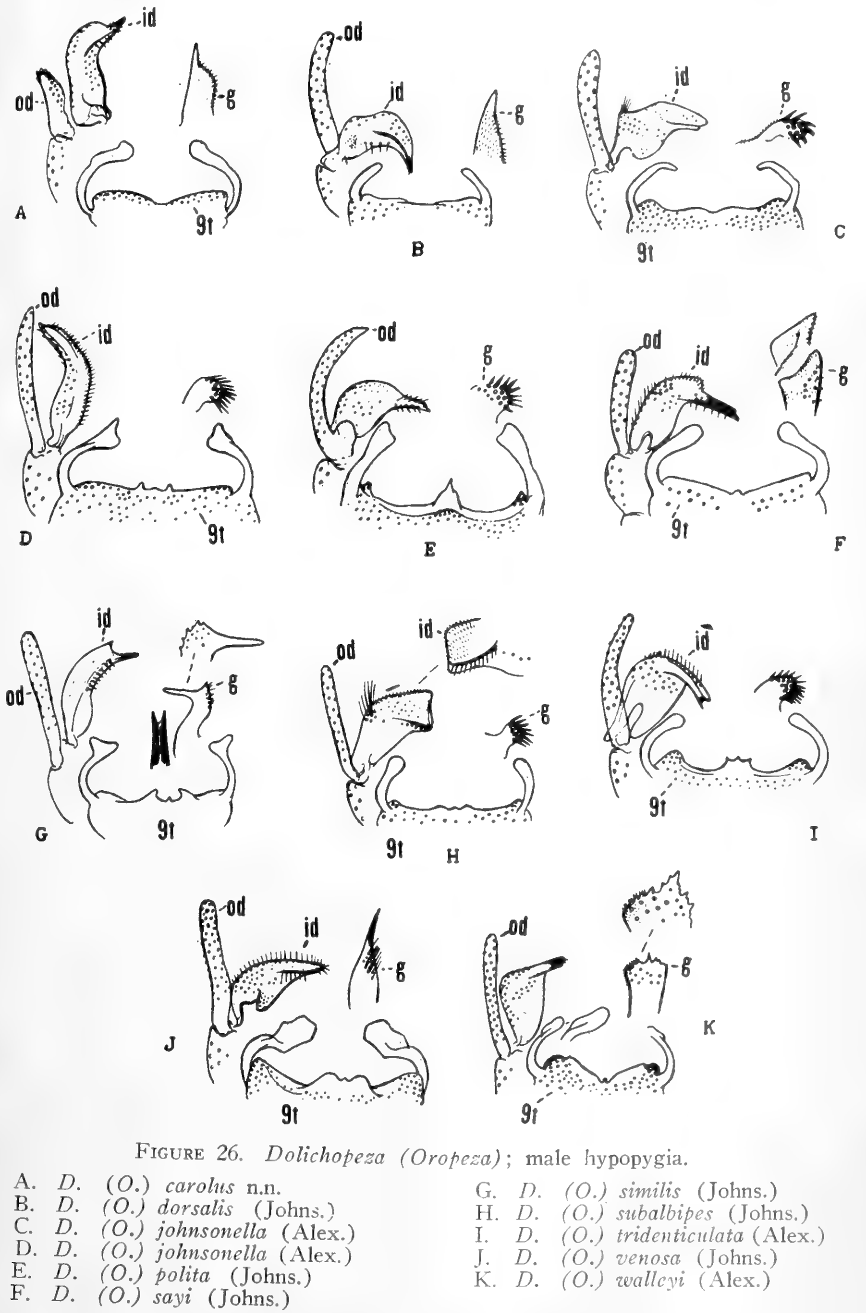


FIGURE 26. *Dolichopeza (Oropeza)*; male hypopygia.

A. *D. (O.) carolus* n.n.
B. *D. (O.) dorsalis* (Johns.)
C. *D. (O.) johnsonella* (Alex.)
D. *D. (O.) johnsonella* (Alex.)
E. *D. (O.) polita* (Johns.)
F. *D. (O.) sayi* (Johns.)
G. *D. (O.) similis* (Johns.)
H. *D. (O.) subalbipes* (Johns.)
I. *D. (O.) tridenticulata* (Alex.)
J. *D. (O.) venosa* (Johns.)
K. *D. (O.) walleyi* (Alex.)

Symbols: *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *t*, tergite.

to base of second abdominal segment. Knobs of halteres dark brown. Tarsi a trifle paler than the brown tibiae. Wings strongly infumed; stigma moderately dark brown. Male hypopygium (Fig. 26, D). ♂. L. 8 - 9 mm.; w. 10 - 11 mm.; antenna, about 4 - 4.5 mm. ♀. L. 10 - 11 mm.; w. 10 - 11 mm.

(Mid-June - Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Mich., Wisc. and Minn., southw. to Va., N. C., S. C., Tenn. and Fla.

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); Riverton, July 23, 1931 (C. P. A.); Tunxis State Park, July 23, 1931 (C. P. A.).

D. (*Oropeza*) **polita** (Johns.) (Fig. 26, E).
1909. *Oropeza obscura polita* Johnson; *Ibid.*, 34: 122-123.

Fig.—Johnson, *Ibid.*, pl. 15, fig. 8 (abnorm. ven.).

General coloration dark brown, the surface usually shiny, more rarely opaque reddish brown. Antennae (♂) shorter than in *obscura*, if bent backward extending about to root of halteres. Outer two-thirds of abdomen almost black. Male hypopygium. (Fig. 26, E). ♂. L. 9 - 10 mm.; w. 10.5 - 12 mm.; antenna, about 2.8 - 3 mm. ♀. L. 11 - 12 mm.; w. 11 - 12 mm.

(July, Aug.) Que., N. H., Vt., Mass., N. Y., N. J., westw. to Ind. and Mich., southw. to Va. and N. C. (Canadian, Transition).

Connecticut.—Kent Falls, Aug. 19, 1931 (C. P. A.); Norfolk, July 24, 1931 (C. P. A.).

D. (*Oropeza*) **sayi** (Johns.) (Fig. 26, F).
1823. *Tipula annulata* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 25 (preoccupied).
1909. *Oropeza sayi* Johnson; Proc. Boston Soc. Nat. Hist., 34: 118-119.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 16, fig. 5 (ven.); 1908. Johnson, Proc. Boston Soc. Nat. Hist., 34, pl. 15, fig. 2 (hyp.), fig. 3 (wing); 1909.

Mesonotum with distinct dark brown areas on praescutum and scutum; pleura with large dark areas. Halteres chiefly pale or with knobs only slightly darkened. Tarsi paling to brownish yellow. Stigmal spot dark brown. Abdomen yellow, ringed with brownish black, the latter forming a more or less complete longitudinal median stripe above. Male hypopygium (Fig. 26, F): outer dististyle pale. ♂. L. 9.5 - 10.5 mm.; w. 10.5 - 11.5 mm.

(June, July) N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ohio, Ind. and Mich., southw. to Va., Tenn. and Fla.

Connecticut.—Kent Falls, June 12-13, 1931 (C.P.A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.).

D. (*Oropeza*) **similis** (Johns.) (Figs. 24, B; 26, G).
1909. *Oropeza similis* Johnson; Proc. Boston Soc. Nat. Hist., 34: 119.

Figs.—Johnson, *Ibid.*, pl. 15, fig. 4 (hyp.). Dickinson, Cfls. Wisc., p. 212, fig. 113 (wing); 1932.

Very similar to *sayi* in general appearance. Praescutal stripes and darkened areas of pleura distinct. Halteres yellow. Legs chiefly yellow. Stigma dark brown; a dark seam along vein *Cu*. Male hypopygium (Fig. 26, G). ♂. L. 10 - 11 mm.; w. 11 - 12 mm. ♀. L. 12 - 13 mm.; w. 11.5 - 13.5 mm.

(June, early July) Ont., Me., N. H., Mass., N. Y., Pa., westw. to n. Ind., Mich. and Wisc.

Connecticut.—Tyler Lake, June 13, 1931 (C. P. A.).

D. (*Oropeza*) **subalbipes** (Johns.) (Fig. 26, H).
1909. *Oropeza subalbipes* Johnson; *Ibid.*, 34: 121-122.

Figs.—Johnson, *Ibid.*, pl. 15, fig. 5 (abnorm. ven.), 11 (hyp.).

Similar in general appearance to *carolus*, differing very conspicuously in the male hypopygium (Fig. 26, H): lateral arms of tergite dilated at tips; inner dististyle broad, truncate at apex. ♂. L. 9 mm.; w. 11 - 11.5 mm. ♀. L. 12 - 13 mm.; w. 11 - 12 mm.

(June-Aug.) Ont., Me., N. H., Mass., N. Y., N. J., Pa., westw. to Ind., Mich. and Tenn., southw. to S. C., Fla., Ala. and La. (Transition, Austral).

Connecticut.—Brooklyn, June 15, 1933 (C. P. A.); East River, 1910 (Ely); Kent Falls, May 31, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.).

D. (*Oropeza*) **tridenticulata** Alex. (Fig. 26, I).
1931. *Dolichopeza* (*Oropeza*) *tridenticulata* Alexander: Bull. Brooklyn Ent. Soc., 26: 177-178.

Closely allied to *obscura*. Tarsi a little paler than tibiae. Wings with stigma relatively pale brown, only a little darker than the ground; no dark seam along vein *Cu*. Male hypopygium (Fig. 26, I). ♂. L. about 10 mm.; w. 11 mm.

(Early July) Ont., Mass., westw. to Ind., Mich., and Mo., southw. to S. C. (Canadian).

D. (*Oropeza*) **venosa** (Johns.) (Fig. 26, J).
1909. *Oropeza venosa* Johnson: Proc. Boston Soc. Nat. Hist., 34: 120.

Fig.—Johnson, *Ibid.*, pl. 15, fig. 9 (hyp.).

Brown. Praescutal stripes and pleural areas conspicuous, brown. Knobs of halteres dark brown. Legs obscure yellow, the tarsi clearer yellow. Wings with the stigma dark brown; a brown seam along vein *Cu*. Abdominal tergites with a brown median stripe, at incisures extended laterad almost to margins. Male hypopygium (Fig. 26, J). ♂. L. 10 - 11 mm.; w. 11 - 12.5 mm. ♀. L. 12 - 13 mm.; w. 12 - 13 mm.

(June-early July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to S. C. (Canadian).

Connecticut.—Hamden, June 29, 1928 (R. B. F.); Kent Falls, June 12-13, 1931 (C. P. A.); Norfolk, June 9, 1929; June 12, 1931 (C. P. A.); Riverton, June 12, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Union, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); W. Hartford, June 10, 1929 (R. B. F.); Winsted, June 9, 1929 (C. P. A.).

D. (*Oropeza*) **walleyi** (Alex.) (Fig. 26, K).
1931. *Oropeza walleyi* Alexander: Can. Ent., 63:139-140.

Generally similar to *sayi* in most regards. Pleural darkened areas not distinct, only the ventral sternopleurite a little darker. Knobs of halteres slightly infuscated. Legs brownish yellow. Wings with stigma moderately darkened; no dark seam along vein *Cu*. Abdominal tergites with a brown median stripe. Male hypopygium (Fig. 26, K). ♂. L. 9 - 10 mm.; w. 11 - 11.5 mm. ♀. L. 11 - 12 mm.; w. 12 mm.

(June, July) Que., N. H., Vt., N. Y., N. J., westw. to Ind. and Mich. (Canadian).

Brachypremna Osten Sacken

1886. *Brachypremna* Osten Sacken: Berlin. Ent. Zeitschr., 30:161.

A small genus (about 12 species) of essentially Neotropical crane-flies. Our local species has a vertical dance over a height of some 3 to 4 feet and was aptly termed "the King of the dancing Tipulids" by the late Mr. Charles W. Johnson. The insect is common in open Austral woodlands. The early stages are imperfectly known but are apparently spent in decaying wood.

Brachypremna dispellens (Walk.) (Fig. 24, C).
1860. *Tipula dispellens* Walker: Trans. Ent. Soc. London, (n. s.), 5:334.

Figs.—Johnson, Proc. Boston Soc. Nat. Hist., 34, pl. 16, fig. 16 (ven.); 1909. Alexander, Journ. N. Y. Ent. Soc., 20:227, text-fig. (hyp.), pl. 16, fig. b (wing); 1912. Alexander, Cils. N. Y., 1, pl. 43, fig. 188 (wing); 1919.

Mesonotal praescutum light brown, the extreme margin more whitish; three pale brown stripes, more or less bordered by darker, the median one further divided by a pale vitta; scutellum and mediotergite with two narrow, white, intermediate lines. Pleura whitish, with delicate brown longitudinal stripes. Femora brownish black; tibiae and tarsi whitish. ♂. L. 11.5 - 17 mm.; w. 15 - 21 mm. ♀. L. 15 - 17 mm.; w. 16 - 18 mm.

(June, July) N. J., Ind., Ill., Ky., Tenn., southw. to Fla. and Tex. (on Continent into Tropical Cent. and S. Amer.).

Tanyptera Latreille

1805. *Tanyptera* Latreille; Hist. Nat. Crust. et Ins., 14:286.
1832. *Xiphura* Brullé; Ann. Soc. Ent. France, 1:206.

A small group of Holarctic crane-flies whose specific limits are still poorly understood. In our faunal region, three nominal species are found but the remarkable variation in color strongly indicates that the number of valid forms is less than the figure given and it is very possible that but a single species is found within our limits.

Dr. Townes has recently reported the capture at Ithaca, N. Y., May 31, 1936, of a mating pair, the male being *frontalis*, the female *fumipennis*. The adults frequent open mesophytic or mixed woodlands. They are highly polished, black and yellow to red, superficially resembling ichneumonid Hymenoptera more than they do other craneflies. The larvae live in the relatively sound wood of prostrate hardwood trees.

Key to Species

1. Wings smoky black; body-coloration black, male with feet and abdomen black, female with feet and base of abdomen reddish yellow....... **fumipennis**
   Wings not black.. 2
2. Wings strongly tinted with topazine yellow, the stigma dark brown, in cases with the wing-tip infumed; body-coloration varying from black to yellow; legs reddish yellow....................................... **topazina**
   Wings hyaline, stigma brown; body-coloration ranging from black to yellow **frontalis**

Tanyptera frontalis (O. S.) (Fig. 25, A).
1864. *Ctenophora frontalis* Osten Sacken: Proc. Ent. Soc. Philadelphia, 3:48-49.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 14, fig. 3 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 43, fig. 191 (wing); 1919. Dickinson, Cfls. Wisc., p. 213, fig. 115 (wing); 1932.

Coloration ferruginous to black. Wings hyaline; stigma dark brown. ♂. L. 12-16 mm.; w. 10-12 mm.

(May, June) Que., N. S., Me., N. H., Vt., Mass., N. Y., N. J., westw. to Ill. and Wisc., southw. to Md.

Connecticut.—Tyler Lake, June 13, 1931 (C. P. A.).

T. fumipennis (O. S.)
1864. *Ctenophora fumipennis* Osten Sacken: Proc. Ent. Soc. Philadelphia, 3:47.

Black; wings strongly suffused with blackish: in female, legs and base of abdomen reddish yellow. ♂. L. 13-15 mm.; w. 12-14 mm. ♀. L. 20-22 mm.; w. 13-15 mm.

(Late May-early June) Que., N. H., Vt., Mass., N. Y., N. J., westw. to Minn., Wisc. and Ill., southw. to Va. and N. C.

Connecticut.—Hamden, May 25 (A. B. C.); June 4, 1926 (P. G.); Mt. Carmel, June 10, 1916 (Q.S.L.); Norfolk, June 5, 1919 (M.P.Z.); S. Meriden, May 28 (H. L. J.); Stamford, June 5, 1930 (B. T. R. L.); W. Granby, June 8, 1929 (C. P. A.).

T. topazina (O. S.)
1864. *Ctenophora topazina* Osten Sacken; Proc. Ent. Soc. Philadelphia, 3:47-48.

Fig.—Dickinson, Cfls. Wisc., p. 213, fig. 116 (wing); 1932.

Coloration ferruginous to black: abdomen pale, with a dark dorso-median stripe, in cases abdomen entirely black. Wings tinted

with yellow; stigma dark brown; in cases, wing-tip infumed. ♂. L. 15 - 20 mm.; w. 13 - 15 mm. ♀. L. 20 - 22 mm.; w. 16 mm.

(May-early July) Ont., Que., Me., N. H., Vt., Mass., N. Y., Ohio, westw. to Wisc.

Tanyptera succedens (Walker), described in 1856 from Canada, is a doubtful form that is usually placed with *frontalis*. It is the prior name for species in our local fauna.

Ctenophora Meigen

1800. *Flabellifera* Meigen; Nouv. Class. Mouch., p. 13 (nom. nud.).
1803. *Ctenophora* Meigen; Illiger's Mag., 2:263.
1910. *Phoroctenia* Coquillett; Proc. U. S. Nat. Mus., 37:589.

In this genus, a condition exists that is quite comparable to that found in *Tanyptera*. There are supposed to be nearly a score of species, including two in the local fauna, but the exact status of these flies remains in question. The extreme polymorphism of color found here has been discussed by Johannsen (Maine Agr. Expt. Sta., Bull. 177:32-35; 1910). The adults are not commonly met with in nature, being found flying about in open woodlands. The larvae live in decaying wood.

Key to Species

1. Wings variously patterned, either entirely darkened, or yellowish, with the entire apex beyond cord strongly infumed; body either black, or yellow with dark markings...**apicata**
   Wings nearly hyaline, tinged with yellow in costal region; a large brown cloud between cord and wing-tip, not reaching the apex; thorax yellow, with a cuneate median brown stripe...............................**nubecula**

Ctenophora apicata (O. S.) (Fig. 25, B).

1864. *Ctenophora apicata* Osten Sacken: Proc. Ent. Soc. Philadelphia, 3:46.

Figs.—Johannsen, Maine Agr. Expt. Sta. Bull. 177, fig. 14 (wing); 1910. Alexander, Cfls. N. Y., 1, pl. 43, figs. 189-190 (wing); 1919.

Coloration very varied, ranging from black to reddish yellow, with dark markings. The dark phase in both sexes has the mid-femora black, tibiae and tarsi yellow, the body chiefly polished black; wings blackish brown, with restricted clearer spots along cord. The yellow phase, likewise involving both sexes, is chiefly polished reddish yellow, with restricted black areas; wings yellow, darkened apically. ♂. L. 13 - 15 mm.; w. 13 - 15 mm. ♀. L. 18 - 20 mm.; w. 15 - 17 mm.

(June-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., R. I., N. Y.

Connecticut.—Colebrook, 1905 (American Museum Nat. Hist., part of W. M. Wheeler collection); Killingly, July 3, 1919; Stonington, July 26, 1906 (J. A. H.), Aug. 14, 1914 (I. W. D.); Wallingford, July 14, 1922 (S. W. B.); Waterford, July 18, 1914 (I. W. D.); Woodbury, July 16, 1913 (W. E. B.).

C. nubecula (O. S.)

1864. *Ctenophora nubecula* Osten Sacken: Proc. Ent. Soc. Philadelphia, 3:45-46.

If this fly is distinct from *apicata*, it will be separated best by the wing-pattern, as described in key. It will probably be found to be polychroic, as in *apicata*. ♂. L. 13-15 mm.; w. 13-15 mm. ♀. L. 19-20 mm.; w. 16-18 mm.

(June) Que., Mass., N. Y., N. J., w. to Ill., Tenn. and Mo.

Connecticut.—Rowayton, June 16, 1909 (C. W. J.).

Ctenophora dorsalis Walker (1848), described from Newfoundland, is a doubtful species.

Prionocera Loew

1844. *Prionocera* Loew; Stett. Ent. Zeitg., 5:170.
1863. *Stygeropis* Loew; Berlin. Ent. Zeitschr., 7:298.

A small genus of essentially northern crane-flies. The commonest local species, *fuscipennis*, is found in open marshes, where the larvae live in the rich organic mud.

Key to Species

1. Wings with the cells beyond cord darker brown than those in basal cells; obliterative areas along cord very conspicuous........................**electa**
   Cells of wing about equal in color on both sides of cord.................. 2
2. Wings with a strong fulvous suffusion; obliterative areas at cord restricted to end of *Rs* and basal section of M_{1+2}; praescutum with a capillary dark brown median line..**fuscipennis**
   Wings with a pale brownish to brownish subhyaline tinge; pale areas at cord more extensive; praescutum with a pale median line.............. 3
3. Frontal prolongation of head dark dorsally, broadly yellow on sides... **dimidiata**
   Frontal prolongation of head entirely brownish black..................**sordida**

Prionocera dimidiata (Lw.) (Fig. 25, C).

1865. *Stygeropis dimidiata* Loew; Berlin. Ent. Zeitschr., 9:129.

Ashy-gray, opaque, the praescutum with four dark gray stripes. Abdominal tergites gray, narrowly dark brown medially, broadly yellow laterally; caudal margins very narrowly bordered by pale. ♂. L. 12-13 mm.; w. 13-14 mm. ♀. L. 13-14 mm.; w. 14-15.5 mm.

(July) Man., westw. and northwestw. to Alta. and Alaska.

P. electa Alex.

1927. *Prionocera electa* Alexander; Can. Ent., 59:188-189.

General coloration gray; praescutum yellowish gray, with four dark brown stripes; pleura blue-gray. Wings grayish white, apical cells strongly infumed; obliterative band before cord very conspicuous. ♂. L. about 11.5 mm.; w. 13 mm.

(July) Lab.—Arctic Canada.

P. fuscipennis (Lw.) (Fig. 24, E).
1865. *Stygeropis fuscipennis* Loew; Berlin. Ent. Zeitschr., 9:129.
1901. *Tipula illustris* Doane; Journ. N. Y. Ent. Soc., 9:97-98.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 12, figs. 61-63, 67 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 43, fig. 194 (wing); 1919. Dickinson, Cfls. Wisc., p. 214, fig. 117 (wing); 1932.

Mesonotal praescutum yellowish, the three stripes more yellowish gray, with a capillary dark brown median vitta that ends before suture; mediotergite darker posteriorly; pleura whitish gray, dorsopleural membrane light yellow. Wings with a strong fulvous tinge, costal border more yellowish. Abdomen reddish brown throughout. ♂. L. 9-12 mm.; w. 11-14 mm.

(Apr.; June-Aug.) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Ind., westw. and northwestw. to Idaho, Colo., Wash., Alta. and B. C.

P. sordida (Lw.)
1863. *Stygeropis sordida* Loew; Berlin. Ent. Zeitschr., 7:298.

Brownish black, opaque, including the entire frontal prolongation of head. Praescutal stripes poorly delimited. ♂. L. 11-12 mm.; w. 10-12.5 mm.

(June, July) Mass., northwestw. to Man. and Alta.

Longurio Loew

1869. *Longurio* Loew; Berlin. Ent. Zeitschr., 13:2-3.
1916. *Togotipula* Matsumura; Thous. Ins. Japan, Addit. 2:465.

A small genus, including about a dozen species in the eastern Nearctic, southern Ethiopian and eastern Palearctic regions. One of the local species, *testaceus*, is the largest crane-fly in the fauna. The adult flies occur near rapidly-flowing woodland streams. The larvae are aquatic, living in sand or gravel in the stream-bed, or, more rarely, in saturated submerged wood. The Nearctic species, including the genotype, *testaceus*, have the squamae naked and the tibiae without spurs.

Key to Subgenera

1. Wings with cell M_1 sessile..**Aeschnasoma**
   Wings with cell M_1 petiolate..**Longurio**

Subgenus **Aeschnasoma** Johnson

1909. *Aeschnasoma* Johnson; Proc. Boston Soc. Nat. Hist., 34:115-116.

Longurio (*Aeschnasoma*) **rivertonensis** (Johns.)
1909. *Aeschnasoma rivertonensis* Johnson; *Ibid.*, 34:116.

Figs.—Johnson, *Ibid.*, pl. 16, fig. 13 (wing), figs. 14, 15 (hyp.).

General coloration reddish brown, the praescutum with four clearer reddish brown stripes that are narrowly bordered by dark brown lines; vague dark areas near wing-root. Legs reddish brown, the tips of tibiae narrowly infuscated. Wings strongly tinged with reddish brown, more saturated in costal region. Abdomen reddish brown. ♂. L. 33-35 mm.; w. 18 - 22 mm.; abdomen alone, 27 - 28 mm. ♀. L. about 40 mm.; w. 23 - 24 mm.

(June, July) N. J., Va., N. C.

Subgenus **Longurio** Loew

Key to Species

1. Large (wing, ♂, over 25 mm., abdomen over 30 mm.); cell M_1 of wings with very short petiole..**testaceus**
   Smaller (wing, ♂, under 20 mm., abdomen under 25 mm.); cell M_1 of wings with long petiole..**minimus**

L. (*Longurio*) **minimus** Alex.
1914. *Longurio minimus* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914:605.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 32 (wing). Alexander, Cfls. N. Y., 1, pl. 43, fig. 193 (wing); 1919.

General coloration brownish yellow, thoracic stripes indistinct, pleura dull yellow. Legs brownish yellow, the tips of femora and tibiae broadly brown. Wings subhyaline, cell *Sc* and apex very narrowly infumed; stigma and a conspicuous cloud on anterior cord, dark brown; cell M_1 long-petiolate; *m-cu* at or close to midlength of cell *1st* M_2; M_{3+4} distinct, shorter than distal section of Cu_1. ♂. L. 20 - 22 mm.; w. 14 - 16.5 mm.; abdomen alone, 16 - 18 mm. ♀. L. 25 - 27 mm.; w. 16 - 16.5 mm.; abdomen alone, 20 - 22 mm.

(June-Aug.) N. C., S. C., Tenn., Ga. (In mts.)

L. (*Longurio*) **testaceus** Lw. (Fig. 24, F).
1869. *Longurio testaceus* Loew; Berlin. Ent. Zeitschr., 13:3.

Figs.—Alexander, Cfls. N. Y., 1, pl. 43, fig. 192 (wing); pl. 49, fig. 256 (hyp.); pl. 53, fig 329 (hyp.); 1919.

Mesonotal praescutum obscure yellow, with three reddish brown stripes, the median one paler yellow medially, divided by a capillary dark brown vitta; an extensive pale yellow median line, including scutum, scutellum and base of mediotergite; pleura pruinose in front, more whitish behind. Legs obscure yellow; tips of femora and tibiae conspicuously dark brown. Wings (Fig. 24, F) pale gray, brightened at base; narrow brown seams along cord and vein *Cu*; M_{3+4} subequal to distal section of Cu_1. ♂. L. 45 - 50 mm.; w. 26 - 28 mm.; abdomen alone, 36 - 42 mm. ♀. L. 45 - 60 mm.; w. 28 - 33 mm.; abdomen alone, 38 - 50 mm.

(July) Me., N. H., Mass., N. Y., N. J., southw. to Va., N. C., S. C., Ga., Tenn. and nw. Fla.

Nephrotoma Meigen

1800. *Pales* Meigen: Nouv. Class. Mouch., p. 14 (nom. nud.).
1803. *Nephrotoma* Meigen: Illiger's Mag., 3:262.
1834. *Pachyrrhina* Macquart; Hist. Nat. Ins., Dipt., 1:88.

A large genus of often similar flies, especially characteristic of the Holarctic and Ethiopian Regions, much less common in Australasia and the Neotropics. As a rule, members of this genus may be told from *Tipula* by the polished body, in our commonest species (*ferruginea*) of a rusty-red, in other species testaceous or yellow, often variegated with black. A very few species are opaque, while, conversely, a small number of *Tipula* species (*Nobilotipula*, *Nitiditipula*) have the body polished. The immature stages are chiefly spent in earth or in leaf mold.

The present account is based chiefly on a treatment by Dietz (1918), since I have not been able to study the types of several of the species. Many of these have been based on details of coloration and the validity of certain species is questionable. Much work must be done before we have an accurate idea of synonymy and distribution of these flies in the present fauna. In 1939, while the present paper was ready for the press, Professor J. Speed Rogers was able to examine the Dietz types and has furnished me with a statement of his opinion concerning the identity of many of the species. I have added his notes following the species in question.

Key to Species

1. Head and thorax almost uniformly black; abdomen reddish basally, the terminal segments black.......... **altissima erythrophrys**
   General coloration of body yellow or brownish yellow, often with black or rusty markings.......... 2
2. Thoracic stripes black 3
   Thoracic stripes, when present, not black.......... 10
3. Anterior ends of lateral praescutal stripes curved laterad into an opaque velvety-black spot.......... 4
   Lateral praescutal stripes straight 6
4. Occiput opaque, yellow; wing-tip clear .... **virescens**
   Occiput with a polished triangular brand; wing-tip darkened.......... 5
5. Sides of pronotal scutum and the abdomen conspicuously spotted with black or dark brown; pleura variegated with reddish brown to dark brown; mouth parts darkened .... **incurva**
   Pronotal scutum and abdomen chiefly yellow; pleural spots ochre-yellow; mouth parts yellow .... **perdita**
6. A black spot between antennal bases 7
   No black spot between antennal bases 8
7. Wings nearly hyaline, only the stigma, a seam on anterior cord and the very narrow apex darkened.......... **pedunculata**
   Wings with the costal region conspicuously yellow, the other cells before cord strongly suffused with brown; cells beyond cord more nearly clear **lugens**
8. Median region of mesonotal scutum with a dark line; a velvety-black spot opposite anterior end of lateral praescutal stripe but entirely disconnected therefrom .... **sphagnicola**
   Median region of scutum pale; no black velvety spot, as above 9

9. Posterior vertex obscure yellow, with a broad median darkening that attains the margin of the eye or nearly so; wings tinged with brownish, especially along cord and in apical portion; flagellar segments (♂) strongly incised .... **penumbra**
A narrow black median stripe on the otherwise bright-colored posterior vertex; wings clear light yellow; flagellar segments (♂) less strongly incised .... **vittula**
10. Mesonotum opaque or nearly so.......... 11
Mesonotum polished.......... 19
11. Wings with macrotrichia in cells.......... **hirsutula**
Wings without macrotrichia.......... 12
12. Lateral and caudal margins of abdominal tergites black... **macrocera dietziella**
Abdominal tergites not so patterned, with linear black lateral dashes...... 13
13. Antennae (♂) elongate, if bent backward extending to beyond midlength of abdomen. 14
Antennae short in both sexes.......... 16
14. Male hypopygium with the 8th sternite terminating in a median cone...... **macrocera gnata**
Male hypopygium with the 8th sternite terminating in two finger-like lobes. 15
15. Flagellar segments bicolorous.......... **macrocera macrocera**
Flagellar segments uniformly dark brown or black.......... **macrocera atrocera**
16. Male hypopygium enlarged; inner dististyle appearing as a conspicuous serpentine rod .... **cornifera**
Male hypopygium small; inner dististyle inconspicuous.......... 17
17. Antennal flagellum entirely dark brown.......... **tenuis nigroantennata**
Antennal flagellum weakly bicolorous; bases of segments restrictedly yellowish 18
18. Appendage of aedeagus small, inconspicuous.......... **tenuis tenuis**
Appendage of aedeagus large and protuberant, strongly elbowed.. **tenuis hamata**
19. Lateral praescutal stripes curved laterad into an opaque velvety-black spot.. 20
Lateral praescutal stripes not as above 23
20. Occiput opaque, immaculate .... **punctum**
Occiput with polished brand.......... 21
21. Flagellar segments weakly bicolorous; a brown median line on anterior vertex .... **calinota**
Flagellar segments unicolorous; vertex unmarked.......... 22
22. Mesonotal scutum with a narrow black median stripe; antennal flagellum blackish .... **opacivittata**
Mesonotal scutum without such a stripe; antennae entirely yellowish...... **evasa**
23. Flagellar segments unicolorous.......... 24
Flagellar segments bicolorous 31
24. Antennae entirely yellow to brownish yellow.......... 25
Antennal flagellum beyond base uniformly blackened.......... 26
25. Occiput shiny, with a large triangular spot that is a little darker; antennal flagellum brownish yellow.......... **festina**
Occiput with a narrow dark brown line; antennae yellow.......... **temeraria**
26. Occiput entirely polished but chiefly pale in color.......... 27
Occiput opaque, with polished triangular brand 28
27. Posterior vertex and occiput unicolorous.......... **sodalis**
Posterior vertex and occiput with a narrow black median stripe..... **occipitalis**
28. A black spot at lateral end of transverse suture.......... 29
No such blackened area.......... 30
29. Abdominal tergites with row of dark spots.......... **ferruginea**
Abdominal tergites each with latero-posterior margins black.... **beutenmuelleri**
30. Stigma brownish yellow .... **occipitalis**
Stigma dark brown .... **gracilicornis**
31. Flagellar segments at base dark brown or black.......... 32
Flagellar segments at base yellow.......... 37
32. Occiput polished 33
Occiput opaque, with a polished triangle.......... 36

33. No blackish tinge at lateral ends of transverse suture; thoracic stripes poorly defined 34
A blackened area at lateral end of transverse suture; thoracic stripes more clearly indicated 35
34. Orange; abdominal tergites with lateral rows of black spots..... **xanthostigma**
Testaceous to ferrugineous; abdominal tergites with a lateral stripe, the segments banded posteriorly with black.......... **cingulata**
35. Abdomen with dorsal and lateral rows of black spots.......... **obliterate**
Abdomen with lateral stripes; tergites banded posteriorly with black...... **wyalusingensis**
36. Wings with cells *C* and *Sc* hyaline; stigma subfuscous.......... **abbreviata**
Wings with cells *C* and *Sc* infumed; stigma yellowish brown.......... **suturalis**
37. Antennae with 13 segments.......... 38
Antennae with 16 or more segments.......... 41
38. A black spot before anterior end of each lateral praescutal stripe... **clandestina**
No such darkened marks on praescutum.......... 39
39. Lateral and posterior margins of abdominal tergites black.......... **approximata**
Abdominal tergites with lateral rows of black spots.......... 40
40. Flagellar segments excised beneath; abdominal tergites with median row of spots .... **breviorcornis**
Flagellar segments cylindrical; abdominal tergites with a continuous dark stripe .... **stigmatica**
41. Antennae (♂) 19-segmented .... **eucera**
Antennae (♂) with 16 or 17 segments.......... 42
42. Stigma yellowish brown; wing-apex not darkened.......... **euceroides**
Stigma dark brown; wing-apex distinctly darkened.......... **polymera**

Nephrotoma abbreviata (Lw.)

1863. *Pachyrrhina abbreviata* Loew; Berlin. Ent. Zeitschr., 7:295.

Occiput orange; brand of moderate size, shiny, concolorous; palpi pale; antennae yellow, flagellar segments darkened basally. Thoracic stripes ochraceous; ends of suture black. Wings hyaline; stigma subfuscous; apex infuscated. Abdomen variegated with black, the median area larger trigonal, lateral areas minute. ♀. L. about 11-12 mm.; w. 11-12 mm.

Miss. (Austral). Recorded by Dickinson (1932) from Wisc., probably in error.

Prof. Rogers considers this as very possibly being a member of the *ferruginea* complex of forms and only doubtfully distinct from *ferruginea*.

N. altissima erythrophrys (Will.)

1877. *Pachyrrhina altissima* Osten Sacken; Bull. U. S. Geol. Surv., 3:210.

1893. *P. erythrophrys* Williston; Kansas Univ. Quart., 2:63.

Fig.—Dickinson, Cfls. Wisc., p. 216, fig. 118 (wing); 1932.

Typical form almost entirely black, sides of posterior vertex obscure reddish. Form *erythrophrys* with more reddish coloration, especially the basal abdominal segments; terminal segments entirely blackened. ♂. L. 9-11 mm.; w. 8-10 mm. ♀. L. 16-18 mm.; w. 11-12 mm.

(June, July) Rocky Mt. Reg., Alta. to N. M., eastw. to Minn., Wisc., Ill. and Mich.; Man. and w. Ont. (Hudsonian, high Canadian).

Prof. Rogers is of the opinion that this species and form may represent extreme melanistic types of *lugens* and be placed as subspecies under that species.

N. approximata (Dtz.)
1918. *Pachyrhina approximata* Dietz: Trans. Amer. Ent. Soc., 44:136-137.

Figs.—Dietz, *Ibid.*, pl. 5, fig. 19 (wing); pl. 7, fig. 33 (hyp.).

Close to *breviorcornis*. Antennae (♂) long, slender, if bent backward extending to beyond base of abdomen; flagellar segments brown, ferruginous at bases. Occiput shiny; median stripe dark. Thoracic stripes rusty brown. Wings grayish; stigma brownish yellow. Abdominal tergites with black lateral stripes, margined posteriorly with brown. ♂. L. 12 mm.; w. 12 mm.

(Aug.) Pa.

Considered by Prof. Rogers as being identical with *breviorcornis*, the supposed differences in coloration of the abdomen apparently being due to post-mortem changes.

N. beutenmuelleri (Dtz.)
1918. *Pachyrhina beutenmuelleri* Dietz; Trans. Amer. Ent. Soc., 44: 130-131.

Fig.—Dietz, *Ibid.*, pl. 5, fig. 14 (wing).

Close to *ferruginea*. Flagellum beyond basal segment blackish; a dark brown orbital spot; occipital brand shiny, rusty, produced cephalad to summit of vertical tubercle. Thoracic stripes rusty; lateral ends of suture blackened. Abdominal segments bordered laterally and posteriorly with black. ♂. L. 10.5 mm.; w. 10.5 mm.

(Sept.) Pa.—N. C., westw. to Mich. Recorded by Dickinson (1932) from Wisc., perhaps erroneously.

Prof. Rogers considers this to represent only a variant, or perhaps merely an individual variation of *ferruginea*.

N. breviorcornis (Doane)
1908. *Pachyrhina breviorcornis* Doane: Ent. News, 19:178-179.

Fig.—Dickinson, Cfls. Wisc., p. 219, fig. 126 (wing); 1932.

General coloration yellow; thoracic stripes reddish brown. Antennae with flagellar segments gently excised on lower face. Abdomen with rows of spots; median tergal row less distinct behind. ♂. L. 13-14 mm.; w. 12.5-13 mm.

(June, July) Ont., Que., N. H., Mass., N. Y., westw. to Ill., Mich., Wisc., and Ia., southw. to N. C. and S. C.

Connecticut.—Kent Falls, June 12-13, July 23-24, 1931 (C. P. A.); Union, Aug. 17-18, 1928 (C. F. C.); W. Granby, June 8, 1929 (C. P. A.).

N. calinota (Dtz.)
1918. *Pachyrhina calinota* Dietz: Trans. Amer. Ent. Soc., 44: 121-122.

Fig.—Dietz, *Ibid.*, pl. 4, fig. 7 (wing).

Yellow; thoracic stripes silvery-gray pruinose, margined with ferruginous; median stripe further divided by a black line; median region of scutum with an elongate dark spot. Frontal prolongation of head and posterior vertex with a median brown line. Abdominal tergites with a series of large brown median spots. ♂. L. 13 mm.; w. 11 mm. ♀. L. 18 mm.; w. 12 mm.

(June, July) N. H., N. Y., westw. to Mich., southw. to Md. and Tenn.

N. cingulata (Dtz.)
1918. *Pachyrhina cingulata* Dietz; Trans. Amer. Ent. Soc., 44: 131-132.

Figs.—Dietz, *Ibid.*, pl. 5, fig. 17 (wing), pl. 7, fig. 30 (hyp.).

Close to *xanthostigma*. General coloration testaceous to ferruginous, the praescutal stripes ill-defined. Antennae (♂) elongate; flagellar segments bicolored, dark brown basally. Wings strongly tinged with yellow, costal and cubital regions more saturated; stigma pale brown. Abdomen with tergites banded posteriorly with black, more evident in female. ♂. L. 13 mm.; w. 11 mm. ♀. L. 16 mm.; w. 13 mm.

(June-Aug.) Pa.; in marshy locality.

Prof. Rogers states that this is the species commonly recognized by authors as being *xanthostigma* but is not identical with the type specimen of Loew's species.

N. clandestina (Dtz.)
1921. *Pachyrhina clandestina* Dietz: Trans. Amer. Ent. Soc., 47: 262.

Close to *breviorcornis*. Antennae with flagellar segments excised beneath. Thorax sulfur-yellow; praescutal stripes reddish brown, sharply defined; a well-defined black area at humerus. Abdomen with a lateral row of oblique dark dashes. ♀. L. 15.5 mm.; w. 13.5 mm.

(June) Pa.

Prof. Rogers has noted that this is very close to *breviorcornis*, of which it may be found to represent a valid race.

N. cornifera (Dtz.)
1918. *Pachyrhina cornifera* Dietz: Trans. Amer. Ent. Soc., 44: 120-121.

Figs.—Dietz, *Ibid.*, pl. 4, fig. 6 (wing), pl. 6, fig. 25 (hyp.).

Yellow, opaque; praescutal stripes yellowish red, more shiny. Flagellar segments beyond second brown. Wings tinged with yellow; stigma dark brown. Abdomen with lateral spots on tergites; male

hypopygium large and conspicuous, the inner dististyle appearing as a slender, twisted, serpentine rod. ♂. L. 14 mm.; w. 15 mm.

(July) Va., N. C., n. Fla. (Austral).

N. eucera (Lw.)
1863. *Pachyrrhina eucera* Loew: Berlin. Ent. Zeitschr., 7: 296.

General coloration yellow. Occiput unmarked, entirely polished. Antennae (♂) elongate, 19-segmented; of ♀ shorter, 15-segmented; flagellar segments strongly excised beneath. Wings yellow; stigma more brownish yellow. ♂. L. about 14-15 mm.; w. 14-15 mm. ♀. L. 18-20 mm.; w. 17-18 mm.

(May-Aug.) Que., Mass., R. I., N. Y., Pa., westw. to Wisc., Ia., Mo. and Kan., southw. to Va., s. Ill. and Tenn. (Transition).

Connecticut.—Danbury, June 15, 1909 (C.W.J.).

N. euceroides Alex.
1919. *Nephrotoma euceroides* Alexander; Can. Ent., 51: 172.

Generally similar to *eucera*. Antennae (♂) shorter, 17-segmented; terminal segment very reduced. Praescutal stripes reddish brown, distinct. Wings grayish yellow; stigma pale. ♂. L. 14-14.5 mm.; w. 13.5-15 mm.

(June) Que., N. B., Me., N. H., Mass., N. Y., westw. to Mich. (Canadian).

Connecticut.—Guilford, June 6, 1905 (W. E. B.); Norfolk, June 9, 1929 (C. P. A.); Southington, May 28, 1930 (R. B. F.); Storrs, 1931, 1932 (C.S.C.); Tyler Lake, June 13, 1931 (C. P. A.).

N. evasa (Dtz.)
1918. *Pachyrhina evasa* Dietz; Trans. Amer. Ent. Soc., 44: 124-125.

Fig.—Dietz, *Ibid.*, pl. 4, fig. 10 (wing).

Characters as in *calinota*. Antennae (♀) entirely yellowish. Occiput with triangular brand. Scutum without median black line. Abdominal segments yellow with pale brown subterminal triangles, the caudal borders ferruginous. ♀. L. 18 mm.; w. 13.5 mm.

(July) Mich.

Prof. Rogers believes this may prove to have been based on a teneral individual of *calinota*.

N. ferruginea (Fabr.) (Fig. 24, G).
1805. *Tipula ferruginea* Fabricius; Syst. Antl., p. 28.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 11, figs. 55, 56 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 44, fig. 198 (wing); 1919. Young, Cornell Univ., Agr. Expt. Sta., Mem. 44: 283, pl. 9, fig. 3 (thorax); 1921. Dickinson, Cfls. Wisc., p. 220, fig. 129 (wing); 1932.

Readily told by the rusty-red stripes, in conjunction with the blackened ends of the transverse suture. Outer end of cell R_5 usually with a small group of macrotrichia. ♂. L. 10-12 mm.; w. 10-11 mm. ♀. L. 15-16 mm.; w. 11-12 mm.

(May, June; Aug., Sept.) Generally distributed in eastern North America, westw. to Alta., Colo. and N. M., southw. to Ga., La. and Tex.

Connecticut.—Compo Beach, May 23, 1916 (I. N. G.); Cromwell, Willow Isl., Aug. 9, 1924 (Unger); East River, Sept. 10 (Ely); Granby, May 21, 1917 (M. P. Z.); Hamden, May 24, 1926 (J. L. R.), Aug. 31, 1932 (N. T.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Mansfield, June 25, 1920 (J. A. M.); Milford, June 12, 1917 (M. P. Z.); New Haven, May 26, 1910 (A. B. C.), June 6, 1916 (B. H. W.), June 23, 1923 (W. E. B.); Prospect, Aug. 15, 1906 (W. E. B.); Salisbury, Aug. 5, 1928 (G. C. C.); Storrs, June 25-28, 1920 (J. A. M.); Wallingford, June 17, 1913 (Q. S. L.).

N. festina (Dtz.)

1918. *Pachyrhina festina* Dietz; Trans. Amer. Ent. Soc., 44:126-127 (as lapsus, *perfida*, l. c., p. 128).

Fig.—Dietz, *Ibid.*, pl. 5, fig. 12 (wing).

Close to *sodalis*. Coloration pale yellow, the praescutal stripes chestnut brown to reddish brown. Antennae very slender; outer flagellar segments uniformly brownish yellow, not excised. Abdomen yellow, tergites with ill-defined pale brown median stripe and lateral series of black dashes. ♂. L. 12.5 mm.; w. 12.5 mm.

(July, Aug.) Ont., westw. to Ind., Mich. and Man., southw. to Pa., Md. and N. C.

Prof. Rogers states that this proves to be a straight synonym of *gracilicornis*.

N. gracilicornis (Lw.)

1864. *Pachyrrhina gracilicornis* Loew; Berlin. Ent. Zeitschr., 8:66.

Close to *sodalis*. Occiput subopaque, immaculate. Antennae slender, of moderate length; flagellar segments beyond first dark brown. Praescutal stripes brownish ochreous. Stigma brown. Abdominal tergites with a median brown stripe and lateral black dashes. ♂. L. 11 - 12 mm.; w. 13 - 14 mm. ♀. L. 15 - 16 mm.; w. 13 - 14 mm.

(July, Aug.) N. Y., Md., westw. to Mich.

N. hirsutula (Dtz.)

1918. *Pachyrhina hirsutula* Dietz; Trans. Amer. Ent. Soc., 44:118-119 (as lapsus, *pilosula*, l. c., p. 110).

Fig.—Dietz, *Ibid.*, pl. 4, fig. 4 (wing).

Close to *macrocera*. Cells of wing with sparse macrotrichia. ♂. L. 11.5 mm.; w. 12.5 mm.

(May) Pa.

This and other species of the genus defined by Dietz as having macrotrichia scattered over the wing-surface may be based on artifacts, such as setae broken from the veins and merely lying loose on the wing-surface. Prof. Rogers has confirmed the above observation and found that this name is based on *macrocera* with detached macrotrichia of the veins lying caught among the microtrichia.

N. incurva (Lw.)

1863. *Pachyrrhina incurva* Loew; Berlin. Ent. Zeitschr., 7:293.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 11, figs. 52, 53 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 44, fig. 204 (wing): 1919. Dickinson, Cfls. Wisc., p. 216, fig. 119 (wing); 1932.

General coloration yellow, conspicuously variegated by black, including three praescutal stripes, the outer pair curved laterad into an opaque black spot. Pleura variegated by reddish or reddish brown. Wing-tip narrowly darkened. ♂. L. 10 - 11.5 mm.; w. 10 - 12 mm. ♀. L. 15 - 17 mm.; w. 13 mm.

(June-Aug.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., Wisc., Minn., southw. to N. C., S. C., Tenn. and Fla. (Canadian, Transition).

Connecticut.—Branford, July 15, 1904 (H.W.W.); Cornwall Bridge, June 12, 1931 (C. P. A.); Hamden, July 11, 1914 (W. E. B.).

N. lugens (Lw.)

1864. *Pachyrrhina lugens* Loew; Berlin. Ent. Zeitschr., 8:63.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 11, figs. 51, 54 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 44, fig. 202 (wing); 1919. Dickinson, Cfls. Wisc., p. 217, fig. 122 (wing); 1932.

Orange-yellow, heavily patterned with black. Head with three small spots on front and orbits additional to the relatively small occipital brand. Thoracic stripes subopaque. Costal border of wing more yellow than remainder; stigma dark brown. Basal five abdominal segments conspicuously banded with black. ♂. L. 11 - 13 mm.; w. 11 - 12 mm. ♀. L. 16 - 17 mm.; w. 12 - 13 mm.

(May, June; rarely July, Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., westw. to Minn., Wisc., and Ill., southw. to N. C.

Connecticut.—Guilford, June 14, 1918 (B.H.W.); Hamden, June 23, 1926 (R. B. F.); Hartland, June 9, 1929 (C. P. A.); New Haven, May 24, 1910 (A. B. C.), June 14, 1910 (W. E. B.); Salem, June 12, 1929 (W. E. B.); Storrs; W. Granby, June 8, 1929 (C. P. A.).

N. macrocera (Say)

1823. *Tipula macrocera* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:24.

Figs.—Alexander, Cfls. N. Y., 1, pl. 44, fig. 200 (wing): 1919. Dickinson, Cfls. Wisc., p. 217, fig. 123 (wing); 1932.

Thoracic dorsum yellow or orange-yellow, opaque or nearly so, without markings. Antennae (♂) very long; flagellar segments bicolored. Abdominal tergites with lateral black dashes; sternites with median line of same. ♂. L. 12 - 13 mm.; w. 13 - 14 mm.; antenna 10 - 11 mm. ♀. L. 17 - 18 mm.; w. 15 - 16 mm.

(May-July) N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc., Ia., Mo. and Kan., southw. to S. C., Tenn., Ga., and n. Fla.

Connecticut.—East River, July 26, 1911 (Ely); Hartland, June 9, 1929 (C. P. A.). Kent Falls, June 12-13, 1931 (C. P. A.); Norfolk, July 24, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Union, June 14, 1933 (C. P. A.) Windsor, Aug. 6, 1929 (C. P. A.).

N. m. atrocera (Dtz.) (Dietz, l. c., 44:118; 1918)

As in typical form but with antennal flagellum uniformly brownish black to black. Abdomen with terminal segments slightly more blackened.

(June, July) Ct., Pa.

Connecticut.—Saptree Run State Park, June 14, 1933 (C. P. A.).

Considered by Rogers as a somewhat melanistic individual of *macrocera*.

N. m. gnata (Dtz.) (Dietz, l. c., 44:118; 1918)

Male hypopygium with 8th sternite terminating in a median conelike structure; in typical *macrocera*, terminating in two digitiform lobes.

(Aug.) Wisc.

Prof. Rogers places this in the strict synonymy of *macrocera*.

N. m. dietziella nom. nov. (*virgata* Dietz, Trans. Amer. Ent. Soc., 47:260; 1921, nec *virgata* Coquillett, 1898)

Abdomen with posterior and lateral borders of abdominal tergites black.

(July, Aug.) Me., Pa.

N. obliterata (Dtz.)

1918. *Pachyrhina obliterata* Dietz; Trans. Amer. Ent. Soc., 44:133-134.

Figs.—Dietz, *Ibid.*, pl. 5, fig. 15 (wing), pl. 7, fig. 31 (hyp.).

Close to *xanthostigma*. General coloration polished sulfur-yellow; lateral ends of praescutal stripe suffused with black. Antennae relatively short; flagellar segments bicolorous, blackened basally. Abdomen with a dark dorsal stripe and lateral dashes. ♂. L. 14 mm.; w. 12.5 mm. ♀. L. 16-17 mm.; w. 15-15.5 mm.

(July, Aug.) Ont., Pa., Mich.

A synonym of *sodalis*, according to Prof. Rogers.

N. occipitalis (Lw.)

1864. *Pachyrrhina occipitalis* Loew; Berlin. Ent. Zeitschr., 8:65.

General coloration yellow, the praescutal stripes reddish to ochraceous. A narrow dark brown stripe on posterior vertex and occiput. Wings grayish yellow; stigma yellowish. Abdominal tergites with

a median brown vitta and less evident lateral streaks. ♀. L. 13 - 15 mm.; w. 13 - 14 mm.

(June, July; Sept.) Alta., Sask., Ont., Que., N. B., Mich. (Hudsonian, high Canadian).

N. opacivittata (Dtz.)
1918. *Pachyrhina opacivittata* Dietz; Trans. Amer. Ent. Soc., 44: 123.

Fig.—Dietz, *Ibid.*, pl. 4, fig. 9 (wing).

Close to *calinota*. Posterior vertex unmarked. Flagellar segments relatively stout and moderately incised. Praescutal stripes reddish brown, the median one behind divided by a narrow black vitta. ♂. L. 12 - 12.5 mm.; w. 11 - 12 mm.

(Aug.) Mass., Wisc., Man.

N. pedunculata (Lw.)
1863. *Pachyrrhina pedunculata* Loew; Berlin. Ent. Zeitschr., 7: 293.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 11, figs. 58, 59 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 44, fig. 203 (wing); 1919. Dickinson, Cfls. Wisc., p. 217, fig. 121 (wing); 1932.

Yellow with black markings. A small black spot between bases of antennae. Wings almost uniformly subhyaline; stigma and very narrow apex darker. ♂. L. 12 - 13 mm.; w. 12 - 13 mm. ♀. L. 16 - 18 mm.; w. 12 - 14 mm.

(Late May-early Aug.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., Ill., and Minn. (Canadian).

Connecticut.—Reported from Connecticut by the Experiment Station, without more accurate data.

N. penumbra Alex.
1915. *Nephrotoma penumbra* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 467-468.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 1 (wing); Cfls. N. Y., 1, pl. 44, fig. 205 (wing); 1919.

Coloration obscure yellow, variegated by black or brownish black. Frontal prolongation of head trivittate with dark brown. Antennal flagellum black; flagellar segments strongly incised. Dark markings on vertex and occiput broad, especially at anterior end. Abdomen with middorsal black stripe. ♂. L. 12 - 13.5 mm.; w. 12 - 13.5 mm. ♀. L. 16 - 18 mm.; w. 14 - 15 mm.

(July) N. B., N. H.; alpine and subalpine portions of Mt. Washington, 4000-6290 ft. (Hudsonian).

N. perdita (Dtz.)
1918. *Pachyrhina perdita* Dietz; Trans. Amer. Ent. Soc., 44: 116-117.

Fig.—Dickinson, Cfls. Wisc., p. 217, fig. 120 (wing); 1932.

Close to *incurva*, differing chiefly in colorational details. ♀. L. about 17 mm.; w. 14.5 mm.

(July-Aug.) Wisc., Man. (Canadian).

Prof. Rogers believes this to be synonymous with *nexilis*, which is considered as being a valid western race of *incurva*.

N. polymera (Lw.)
1863. *Pachyrrhina polymera* Loew; Berlin. Ent. Zeitschr., 7:297.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 11, figs. 50, 60 (hyp.); 1904. Dickinson, Cfls. Wisc., p. 219, fig. 127 (wing); 1932.

Yellow; praescutal stripes rusty. Antennae of ♂ 16-segmented, of ♀ 14-segmented; bicolorous. Wings yellowish; stigma brownish black; wing-tip darkened. ♂. L. 11 - 13 mm.; w. 12 - 14 mm. ♀. L. 15 - 16 mm.; w. 13 - 14 mm.

(May-June; Sept.) Ont., N. H., Vt., Mass., N. Y., westw. to Wisc., Ia., and Kan., southw. to S. C. and Tenn. (Transition).

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.); New Haven, July 1, 1928 (W. E. B.); Portland, June 24, 1932 (N. T.).

N. punctum (Lw.)
1863. *Pachyrrhina punctum* Loew; Berlin. Ent. Zeitschr., 7:294.

Occiput opaque, unmarked. Antennae with outer flagellar segments blackish. Pronotum yellow. Praescutal stripes brownish black; a velvety-black spot opposite anterior end of lateral stripe. Wings with blackish brown stigma. Intermediate abdominal segments with a blackish subtriangular area. ♀. L. 15 mm.; w. 13 mm.

(May-July) Me., N. H., Mass., R. I., N. J., Pa., Ill., Mich.

N. sodalis (Lw.)
1864. *Pachyrrhina sodalis* Loew; Berlin. Ent. Zeitschr., 8:64.

Head orange; antennal flagellum beyond second segment black. Praescutum polished, the stripes brownish ochreous; lateral ends of suture blackish; scutellum and postnotum ochreous, unmarked. Wings grayish yellow; costal region and stigma light yellow. Abdominal tergites with a median stripe and a series of lateral black dashes. ♀. L. 17 - 18 mm.; w. 14 - 15 mm.

(May-Sept.) Ont., Que., N. H., Mass., N. Y., N. J., westw. to Mich. and Wisc., southw. to N. C.

Connecticut.—Loew's type taken in Connecticut, without closer data; East River, Sept. 10, 2♂ (Ely); Storrs, June 1928; Windsor, June 5, 1925 larvae, emerged Sept. 9, 1925 (W. E. B.), June 5, 1925 (W. E. B.), June 10, 1925 (B. H. W.); Yalesville, June 27, 1906 (P. L. B.).

N. sphagnicola Alex.
1920. *Nephrotoma sphagnicola* Alexander; Can. Ent., 52:110-111.

Close to *incurva*. Occipital brand broadly subtriangular. Scutum with a narrow black median stripe, in addition to the areas on

the lobes. Wings yellowish; stigma dark brown; wing-tip and a seam on cord darker brown. Abdomen with a broken black dorso-median stripe, with more brownish lateral stripes. ♀. L. 13.5 - 14 mm.; w. 10.5 - 12 mm.

(June, Aug.) Ill., Mich.

N. stigmatica (Dtz.)
1918. *Pachyrhina stigmatica* Dietz; Trans. Amer. Ent. Soc., 44:137-138.

Figs.—Dietz, *Ibid.*, pl. 5, fig. 20 (wing), pl. 7, fig. 34 (hyp.).

Close to *breviorcornis*. Flagellar segments not excised beneath. Abdominal tergites with a continuous median brown stripe; lateral stripes usually interrupted. ♂. L. 14 mm.; w. 12.5 mm.

(Aug.) Pa.

Prof. Rogers considers that this is either *breviorcornis* or extremely close to it.

N. suturalis (Lw.)
1863. *Pachyrrhina suturalis* Loew; Berlin. Ent. Zeitschr., 7:295.

Occiput opaque, the brand concolorous. Antennal flagellum bicolorous, yellow, the bases of segments black. Thoracic stripes ochraceous, the suture black. Wings brownish gray; costal and stigmal regions pale brown. Abdomen unmarked. ♀. L. 10 - 11 mm.; w. 10 - 11 mm.

S. C., Ga., Fla., Ala., coastal.

This form, with its synonym *costomarginata* Dietz, apparently represents an austral or austroriparian race of *ferruginea*.

N. temeraria (Dtz.)
1918. *Pachyrhina temeraria* Dietz; Trans. Amer. Ent. Soc., 44:128.

Fig.—Dickinson, Cfls. Wisc., p. 220, fig. 128 (wing); 1932.

Characters as in *festina*. Antennae (♀) entirely pale yellow. Occiput with a narrow brown vitta. ♀. L. 17.5 mm.; w. 13 mm.

(June, July) Mich., Wisc.

Prof. Rogers indicates that this represents, at most, a race of *gracilicornis*.

N. tenuis (Lw.)
1863. *Pachyrrhina tenuis* Loew; Berlin. Ent. Zeitschr., 7:297.

Figs.—Alexander, Cfls. N. Y., 1, pl. 44, fig. 199 (wing); 1919. Dickinson, Cfls. Wisc., p. 218, fig. 124 (wing); 1932.

Coloration yellow, in life strongly tinged with green. Occiput opaque, immaculate. Antennae short in both sexes; flagellar segments brownish black, restrictedly yellowish at bases. Thorax opaque.

the stripes a little more rusty. Wings yellowish subhyaline, the costal border and stigma clearer yellow. Abdominal tergites with a lateral series of black dashes. ♂. L. 11 - 12 mm.; w. 12 - 13 mm. ♀. L. 16 - 17 mm.; w. 13 - 14 mm.

(May-Sept.) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., southw. to Va., N. C., and Tenn.

Connecticut.—Branford, Aug. 22, 1904 (H. W. W.); Danbury, June 15, 1909 (C. W. J.); New Haven, May 27, 1904 (W. E. B.), June 8, 1904 (W. E. B.), June 9, 1905 (B. H. W.); Storrs, May 1933; Tolland, June 23, 1932 (N. T.); Westville, June 11, 1905 (W. E. B.), June 13, 1907 (W. E. B.).

N. t. hamata (Dtz.) (Dietz, Trans. Amer. Ent. Soc., 44:121: 1918)

Fig.—Dietz, *Ibid.*, pl. 7, fig. 28 (hyp.).

Differs from typical *tenuis* in genitalic structures. Gonapophyses rod-like, strongly bent at midlength.

(Aug.) N. Y.

Considered by Prof. Rogers as a straight synonym of *tenuis*.

N. t. nigroantennata (Dtz.) (Dietz, Trans. Amer. Ent. Soc., 47:261; 1921)

Differs from typical *tenuis* in the entirely dark brown antennal flagellum.

(July) Pa.

Held by Prof. Rogers as being well within the normal color range of typical *tenuis* and not separable therefrom.

N. virescens (Lw.)
1864. *Pachyrrhina virescens* Loew; Berlin. Ent. Zeitschr., 8:62.

Coloration in life strongly greenish, paling to yellow in preserved specimens. Occipital brand lacking. Median praescutal stripe divided by a pale line; lateral stripes and scutal areas chiefly reddish; anterior ends of all stripes, a U-shaped mark at end of suture and a lateral spot on each scutal lobe intense velvety-black. ♂. L. 10 - 12 mm.; w. 10 - 12 mm.

(June-Sept.) N. H., Mass., N. Y., N. J., Pa., westw. to Ill., and Mich., southw. to Tenn., S. C., Ga., and n. Fla. (Transition, Austral).

Connecticut.—East River, Aug. 24, 1910 (Ely); Kent Falls, July 23-24, 1931 (C. P. A.).

N. vittula (Lw.)
1864. *Pachyrrhina vittula* Loew; Berlin. Ent. Zeitschr., 8:63.

Posterior vertex with a narrow but very conspicuous black vitta. Praescutal stripes and pleural markings black; scutellum yellow; mediotergite with a brown median line. Wings grayish subhyaline; stigma subfuscous. Abdominal tergites trivittate with black, the

median stripe entire, the narrower lateral stripes slightly interrupted. ♂. L. 11 mm.; w. 12 - 12.5 mm.

(June-Aug.) Ont., Que., Nfd., Me., N. H., Mass., westw. to Alta. (Hudsonian, high Canadian).

N. wyalusingensis (Dtz.)

1918. *Pachyrhina wyalusingensis* Dietz; Trans. Amer. Ent. Soc., 44:134-135.

Figs.—Dietz, *Ibid.*, pl. 5, fig. 16 (wing), pl. 7, fig. 32 (hyp.).

Close to *xanthostigma*. Lateral ends of suture blackened. ♂. L. 14 mm.; w. 12.5 mm.

(Aug.) Pa.

Type material now reduced to fragments and nothing can be affirmed as to its further relationships (Rogers).

N. xanthostigma (Lw.)

1864. *Pachyrrhina xanthostigma* Loew; Berlin. Ent. Zeitschr., 8:65.

Fig.—Alexander, Cfls. N. Y., 1, pl. 44, fig. 201 (wing); 1919.

General coloration of thorax and abdomen polished orange. Occipital brand very large, embracing also the posterior vertex; vertical tubercle intense orange. Wings strongly suffused with yellow, the costal and apical portions more saturated. Abdominal tergites with lateral rows of black dashes. ♂. L. 12 - 13 mm.; w. 12.5 - 13 mm. ♀. L. 15 - 16 mm.; w. 13 - 14 mm.

(June-Sept.) Ont., Que., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ill., southw. to S. C. and Tenn.

Connecticut.—East River (Ely); New Haven, July 20, 1904 (determined by Johnson as *eucera*) (W. E. B.); Orange, July 14, 1924; Stonington, July 26, 1906 (J. A. H.): Wading River, July 25, 1914 (G. P. E.); Windsor, Aug. 6, 1929 (C. P. A.).

Tipula Linnaeus

1758. *Tipula* Linnaeus; Syst. Nat., Ed. 10:585.

The genus *Tipula* includes approximately one-sixth of all the crane-flies of the World and very nearly one-fourth of all those considered in the present treatment. In this vast series of species there is to be found a considerable range in size but scarcely any differences of importance in the wing venation. The chief specific characters lie in the nature of the wing-pattern and in the structure of the male hypopygium. Various attempts have been made in the past to divide this cumbersome genus into smaller groups, and, more recently, into subgenera. A notable paper by Edwards (Ann. Mag. Nat. Hist. (10) 8:73-82; 1931) is a landmark in the discovery and correlation of characters suitable for the separation of the various subgeneric groups.

The immature stages frequent a wide range of ecological habitats, from species that are aquatic to others living in saturated earth and débris at the margins of streams; others in damp leaf mold in woods; others in dry earth, moss cushions, or even in relatively dessicated garden soil. The adults of some of the species are among the largest of our Diptera, while even the smallest of the local species are still far above the average size for the family.

Key to Subgenera

1. Outer cells of wings with macrotrichia.......................... **Trichotipula**
   Cells of wings without macrotrichia.......................... 2
2. Coloration of body polished and patterned with yellow and black, or yellow and rusty-red, with *m-cu* inserted beyond base of cell *1st* M_2 (at or before this cell in *Nephrotoma*).......................... 3
   Coloration of body opaque, pruinose or pollinose, usually gray brown or yellow, never with the contrasted colors found in *Nephrotoma*.......... 4
3. Wings with *m-cu* close to or just beyond base of cell *1st* M_2; veins M_1 and M_2 with macrotrichia; ovipositor with elongated sclerotized cerci **Nitidotipula**
   Wings with *m-cu* some distance beyond base of cell *1st* M_2; M and its branches without macrotrichia; ovipositor with short and fleshy cerci **Nobilotipula**
4. *Rs* unusually long, fully twice *m-cu*, in alignment with R_{4+5}, the basal deflection of the latter lacking; *m-cu* uniting with M_{3+4} some distance before fork of latter, very rarely at fork; anepisternum with setae; pleurotergal tubercle conspicuous; large species (wings, ♂, 22-25 mm.; ♀, 27-30 mm.) .... **Nippotipula**
   Rs of moderate length, ranging in length to one-half longer than *m-cu*; in rarer cases (*Yamatotipula, Vestiplex, Oreomyza*) attaining to fully twice the length but, if so, with basal section of R_{4+5} present; *m-cu* inserted at fork of M_{3+4} or beyond on base of M_4 (except in *Tipula dickinsoni*); anepisternum glabrous; pleurotergal tubercle lacking or but feebly developed; usually much smaller species (but in *valida*, wing, ♂, 20-24 mm. ♀, 22-24 mm.).......................... 5
5. Wings with *m-cu* unusually long, so cell M_4 is very deep and much wider at base than at margin; vein Cu_1 not conspicuously constricted at point of insertion of *m-cu*; male hypopygium with midregion of tergite extended into a median compressed blade, rarely depressed (if so, *Tipula idei* the lobe glabrous, its apex not roughened by points, as in *Tipula* and *Yamatotipula*) .... **Schummelia**
   Wings with *m-cu* of moderate length, so cell M_4 is short and but little wider at base than at margin; Cu_1 more constricted or shirred at point of insertion of *m-cu*; male hypopygium with tergite not extended into a median compressed blade (in *Yamatotipula* and *Tipula*, *oleracea* group, with a median entire or bifid depressed lobe).......................... 6
6. Ovipositor with hypovalvae greatly reduced, the cerci correspondingly large, heavily sclerotized, placed horizontally and with the margins serrate; male hypopygium with the caudal portion of tergite (Fig. 27, A-D) bearing a shallow, often blackened and polished saucer; claws (♂) simple .... **Vestiplex**
   Ovipositor with hypovalvae well-developed; cerci either reduced and fleshy (*Arctotipula*; *Lunatipula*, *bicornis* group), or, usually, elongate and slender, the margins never serrate; male hypopygium without a tergal saucer; claws (♂) usually with a basal tooth.......................... 7
7. Male hypopygium with sclerites fused into a continuous ring (more separated in *iroquois*, which has the tergite much as in other *Yamatotipula*); claws (♂) toothed 8
   Male hypopygium with the ninth tergite and sternite separated by pale membrane; claws (♂) toothed or simple.......................... 9

8. Wings with *m-cu* usually at or near midlength of cell *1st* M_2; wings not striped longitudinally, at most with costal border darkened; male hypopygium with median region of tergite produced (*oleracea* group) or notched (*ultima* group, Fig. 29, A-C). .... **Tipula**
Wings with *m-cu* usually close to fork of *M*; wings usually with a longitudinally striped or vittate pattern, or, (*iroquois*) with apex darkened; male hypopygium with median region of tergite produced into a simple or bifid usually roughened lobe or lobes, Fig. 28, A-O....... **Yamatotipula** 247
9. Wing-veins almost without trichia, there being none on *M* or its branches; squama naked; claws simple; Northern and Arctic............. **Arctotipula**
Wing-veins with conspicuous trichia; squama naked or with a group of setae; claws (♂) of local species toothed.......................... 10
10. Squama naked; wing-pattern clouded or marbled with brown........ **Oreomyza** 245
Squama with a small group of setae; wing-pattern commonly unicolorous or subunicolorous, more rarely marmorate .... **Lunatipula**

In the following discussion of the local species of *Tipula*, virtually all names that have been applied to the forms in question will be found, either as valid names for the species or as synonyms. There remain a few further species that are not definitely recognizable and are herein considered as being doubtful species. In order to complete the data, these remaining forms are listed herewith.

Tipula frigida Walker; List Dipt. Brit. Mus., 1:68; 1848. Described from Nova Scotia; type apparently lost (Edwards, *in litt.*).

Tipula maculatipennis Say; Long's Exped. to St. Peter's River, Append., p. 359; 1824; and Complete Writings, 1:243; 1859. Name later changed to *maculipennis* by Wiedemann (Aussereur. Zweifl. Ins., 1:46; 1828). Type lost with the destruction of the Say Collection during the 1840's. Material in the Harris Collection suggests that the species may be *dorsimacula* Walker but under the circumstances it seems best to consider the species as being unrecognizable.

Tipula pratorum Kirby; Fauna Boreali Americana, 4:3101; 1837. (Reprinted, Can. Ent., 13:164-165; 1881). Arctic America. Species unrecognizable from description.

Tipula retorta van der Wulp; Tijdschr. v. Entomol., 24:149; 1881. Described from eastern Canada; not definitely recognized since its original definition.

Subgenus **Trichotipula** Alexander

1915. *Tipula* (*Trichotipula*) Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:468-469.
1915. *T.* (*Cinctotipula*) Alexander; *Ibid.*, 1915:469.
1919. *T.* (*Odontotipula*) Alexander; Cornell Univ. Agr. Expt. Sta. Mem. 25:939.

Rs short, arcuate, subequal to *m-cu*, the latter connecting with M_4 close to origin; M_{3+4} short to very short. Cells beyond cord with macrotrichia. Squama naked. Tibial spur formula 1-2-2. No sternopleural setae.

Key to Species

1. Trichiation of wing-cells extensive, including all apical cells from R_1 to M_4 inclusive; praescutal stripes dark. (*Trichotipula*) .... **oropezoides**
   Trichiation of wing-cells restricted, confined to cells R_3 to *2nd* M_2, inclusive; praescutal stripes paler than the interspaces 2
2. Coloration bright polished yellow, reddish and black; vertex polished, with a linear median darker stripe; antennae (♂) short, not attaining the wing-root; trichia of cells restricted to a small group in cell R_5 and, rarely, in cell M_1 (*Odontotipula*) .... **unifasciata**
   Coloration dull brown and yellow, the praescutal stripes paler than the interspaces; vertex opaque, unmarked; antennae (♂) elongate, reaching about to base of abdomen; trichia of cells including cells R_3 to *2nd* M_2 (*Cinctotipula*). 3
3. Antennae with flagellar segments bicolorous; basal enlargements of individual segments black, the remainder yellow .... **unimaculata**
   Antennae with flagellar segments uniformly darkened .... **algonquin**

Tipula (*Trichotipula*) **algonquin** Alex.

1915. *Tipula* (*Cinctotipula*) *algonquin* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1915: 469-471.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 2 (wing), pl. 17, fig. 24; pl. 19, fig. 44; pl. 20, fig. 61 (hyp.). Alexander, Cfls. N. Y., 1, pl. 43, fig. 197 (wing); pl. 49, fig. 260; pl. 53, fig. 324 (hyp.); 1919.

Basal two antennal segments dull yellow. Praescutal stripes brownish yellow, interspaces dark brown. Abdominal tergites light yellow, posterior borders of segments with broad dark margins. ♂. L. 11.5 - 12.5 mm.; w. 11 - 12.5 mm.; antenna, 5.5 - 6 mm. ♀. L. 13.5 - 14 mm.; w. 13 - 13.5 mm.

(July-Sept.) Ont., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ind. and Mich., southw. to N. C. and Tenn.

Connecticut.—Salisbury, Sept. 12, 1928 (G. C. C.).

T. (*Trichotipula*) **oropezoides** Johns.

1909. *Tipula oropezoides* Johnson; Proc. Boston Soc. Nat. Hist., 34: 131-132.

Figs.—Alexander, Cfls. N. Y., 1, pl. 43, fig. 195 (wing), pl. 49, fig. 258, pl. 53, fig. 330 (hyp.); 1919.

General coloration dull gray to yellowish gray. Antennae short in both sexes: flagellum uniformly darkened. Male hypopygium with dorsal portion of sternite produced caudad into a slender, finger-like hairy lobe. ♂. L. 10 - 11.5 mm.; w. 11.5 - 13.5 mm. ♀. L. 14 - 15 mm.; w. 12.5 - 13.5 mm.

(Late May, June) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to S. C., Tenn. and n. Fla.

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Cornwall Bridge, May 30, 1931 (C. P. A.); East River, Sept. 10 (Ely); Kent Falls, May 31, 1931 (C. P. A.), June 12-13, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); May 31, 1931 (C. P. A.) Salisbury, June 10, 1928 (R. B. F.); Storrs (H. W. C.); Winsted, June 9, 1929 (C. P. A.).

T. (*Trichotipula*) **unifasciata** (Lw.)
1863. *Pachyrrhina unifasciata* Loew; Berlin. Ent. Zeitschr., 7:294.
1919. *Tipula unifasciata* Alexander; Cornell Univ. Agr. Expt. Sta. Mem. 25:939, 943.

Figs.—Alexander, *Ibid.*, p. 862 (ven.), pl. 44, fig. 206 (wing), pl. 49, fig. 262 (hyp.); 1919.

Antennal flagellum uniformly darkened. Wings with a band at cord, together with outer radial cells, darkened; basal section of M_3 erect. Abdomen yellow, the segments banded with black. Male hypopygium with dorsal portion of sternite produced caudad into a conspicuous yellow lobe. Ovipositor with elongate valves. ♂. L. 11-12 mm.; w. 10.5-11.5 mm. ♀. L. 15-17 mm.; w. 11.5-13 mm.

(Aug.-Oct.) Ont., Mass., N. Y., N. J., Pa., westw. to Ind., Ill., Mich., Ia. and Kan., southw. to S. C., Ga. and n. Fla.

T. (*Trichotipula*) **unimaculata** (Lw.)
1864. *Pachyrrhina unimaculata* Loew; Berlin. Ent. Zeitschr., 8:64.
1919. *Tipula unimaculata* Alexander; Cornell Univ. Agr. Expt. Sta. Mem. 25:939, 943.

Figs.—Alexander, *Ibid.*, pl. 43, fig. 196 (wing), pl. 49, fig. 259 (hyp.); 1919.

Characters much as in *algonquin*. Wings yellowish; stigma dark brown, conspicuous. Abdominal segments not conspicuously ringed with dark brown. ♂. L. 9-9.5 mm.; w. 9.5-11 mm.; antenna, 6-6.5 mm. ♀. L. 12-13 mm.; w. 8.5-10.5 mm.

(Aug.-Oct.) Ont., Que., Me., Vt., Mass., N. Y., Pa., westw. to Mich. and Ill., southw. to Md. and N. C.

Connecticut.—Kent Falls, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 5-6, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.).

Subgenus **Nobilotipula** subgen. n.
(type *nobilis* Lw.)

General coloration polished yellow and black, almost as in *Nephrotoma*, the praescutal stripes and pleura slightly more pruinose in *collaris*. Macrotrichia of veins very sparse, quite lacking on *M* and its branches. Squama and sternopleurite naked. Tibial spur formula 1-1-2. Ovipositor with very short fleshy valves.

Key to Species

1. Praescutal stripes opaque, dull black or grayish black; pleura pruinose with gray, especially on ventral anepisternum and sternopleurite; basal abdominal tergite gray pruinose .... **collaris**
   Praescutal stripes polished black; pleura light yellow, not or scarcely pruinose; basal abdominal tergite not pruinose.......... **nobilis**

Tipula (*Nobilotipula*) **collaris** Say
1823. *Tipula collaris* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:25.

Fig.—Alexander, Cfls. N. Y., 1, pl. 44, fig. 207 (wing); 1919.

Median praescutal stripe more or less divided by a pale vitta. Wing-tip narrowly darkened. Lateral borders of abdominal tergites and almost all of outer sternites heavily pruinose with silvery. ♂. L. 10 - 12 mm.; w. 11 - 13 mm. ♀. L. 12 - 14 mm.; w. 13 - 16 mm.

(Apr.-June) Que., Mass., R. I., N. Y., N. J., Pa., westw. to Ind. and Mich., southw. to N. C. and S. C.

Connecticut.—Kent Falls, May 31, 1931 (C. P. A.); Norfolk, May 16, 1931 (C. P. A.); Storrs, 1932 (C. H.)

T. (*Nobilotipula*) **nobilis** (Lw.)
1864. *Pachyrrhina nobilis* Loew; Berlin. Ent. Zeitschr., 8:62.

Figs.—Alexander, Cfls. N. Y., 1, pl. 44, fig. 208 (wing), pl. 49, fig. 261 (hyp.); 1919.

Antennal flagellum (♂) brownish black, much paler in ♀. Abdominal sternites and tergites with lateral patches silvery, more conspicuous in female. ♂. L. 12 - 13 mm.; w. 12 - 13 mm. ♀. L. 10 - 12 mm.; w. 12 - 14 mm.

(June, July) Que., N. B., Me., N. H., Mass., N. Y., Mich., southw. to N. C.

Connecticut.—Hamden, June 2, 1928 (R. B. F.); Hartland, June 9, 1929 (C. P. A.); New Haven, June 12, 1929 (R. B. F.).

Subgenus **Nitidotipula** subgen.n.
(type *pachyrhinoides* Alex.)

Characters much as in *Nobilotipula*, especially in the highly polished body which is essentially as in *Nephrotoma*. *Rs* and *m-cu* subequal, the former arcuated, not transverse, as in *Nephrotoma;* cell M_1 petiolate; *m-cu* close to or beyond the fork of *M*. Macrotrichia of veins well-developed, present on M_1 and M_2. Ovipositor with elongate sclerotized cerci.

A single species is known. The group cannot be referred to *Nephrotoma* because of the venation, nor to *Nobilotipula* because of the nature of the ovipositor.

Tipula (*Nitidotipula*) **pachyrhinoides** Alex.
1915. *Tipula pachyrhinoides* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:471-472.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 3 (wing). Alexander, Cfls. N. Y., 1, pl. 44, fig. 209 (wing); 1919.

A median dark stripe on vertex. Thoracic stripes reddish to black; a broad median pale yellow to whitish stripe extending from the suture to base of abdomen. Stigma pale brown; outer radial cells with dusky central darkening. Abdominal segments with caudal margins brown, more or less triangular or ⊥-shaped in outline. ♂. L. 8.5 - 9 mm.; w. 10 mm. ♀. L. 13 - 13.5 mm.; w. 10 mm.

(Aug., Sept.) N. H. (Alpine summits of Mt. Washington), westw. to Minn., Sask. and Alta. (Hudsonian, high Canadian).

Subgenus **Nippotipula** Matsumura

1916. *Nippotipula* Matsumura; Thous. Ins. Japan, Add. 2:457-458.
1931. *Nippotipula* Edwards; Ann. Mag. Nat. Hist., (10) 8:77.

Rs very long, fully twice *m-cu*, the latter close to midlength of cell *1st* M_2, and almost always uniting with M_{3+4} some distance before its fork; in rare cases, *m-cu* at fork of M_{3+4}; *Rs* in direct alignment with R_{4+5}, the basal deflection of the latter lacking. *M* and branches naked. Squama with a group of setae. Tibial spur formula 1-2-2. Setae on sternopleurite and anepisternum. Pleurotergal tubercle well-developed. Scutal lobes with two darkened areas that are ringed with pale. The single regional species is one of the largest and finest of all our species of Tipulidae.

Tipula (*Nippotipula*) **abdominalis** (Say)
1823. *Ctenophora abdominalis* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:18.
1848. *Tipula albilata* Walker; List Dipt. Brit. Mus., 1:65.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 35, fig. 2 (ad. ♀); 1908. Alexander, Cfls. N. Y., 1, pl. 45, fig. 210 (wing); 1919. Dickinson, Cfls. Wisc., p. 232, fig. 141 (wing), p. 248, fig. 175 (hyp.); 1932.

Praescutum and scutum with velvety-black areas that are narrowly ringed with light gray. Pleura longitudinally striped with gray and brownish black. Femora whitish, darkened on outer half, the tips narrowly blackened, preceded by a narrow, dirty white ring; tibiae darkened, with a narrow whitish ring at extreme base. Wings subhyaline, clouded with gray; costal border with three larger brown areas, the first at arculus, second at origin *Rs*, the ocelliform third involving the stigma and extensive seams on anterior cord and outer end of *Rs*; a more or less developed cloud midway between the first two dark areas; a series of small marginal spots at ends of longitudinal veins. Position of *m-cu* variable. Abdominal tergites deep orange, bordered sublaterally with black. ♂. L. 25-30 mm.; w. 22-25 mm. ♀. L. 35-38 mm.; w. 27-30 mm.

(May-July; Aug.-Sept.; apparently two generations, more numerous in late summer.) Ont., Que., Nfd., N. B., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., Wisc. and Kan., southw. to S C., Ga., Ky., Tenn. and Fla. (to Marion Co.).

Connecticut.—New Haven, Aug. 28, 1903 (B. H. W.); N. Branford, July 3, 1931 (G. H. P.); Storrs.

Subgenus **Vestiplex** Bezzi

1924. *Vestiplex* Bezzi; Ann. Mus. Civ. Stor. Nat. Genova, 51:230.

Nasus present or lacking. *Rs* long, fully one-half longer than *m-cu*, in cases even longer. Squama naked; branches of *M* with trichia. Tibial spur formula 1-2-2. Pleura glabrous. Male hypopygium with the posterior half of tergite forming a shallow saucer (Fig. 27, A-D), in several species heavily sclerotized and blackened and with the lateral angles produced caudad into acute spines. In the

two more southern local species, *caroliniana* and *longiventris*, the anterior border of this saucer is indicated by a blackened transverse ridge, the remainder of the area being pale. In the species with a blackened saucer, this often tends to bend ventrad and cephalad, so the only portion visible from above is the anterior or cephalic elevated rim. Ovipositor with cerci strong and powerfully constructed, heavily sclerotized, horizontally placed and with the outer edge serrate; hypovalvae very small or rudimentary.

The species are chiefly Northern and Arctic in distribution. All members of *Vestiplex* have the wings marmorate with brown, gray and white; the praescutal stripes usually strongly margined with brown; and with the male antennae strongly excised beneath, in cases very strongly so. The local species all have the basistyle of the male hypopygium unarmed, except in *caroliniana* and *longiventris*.

Key to Species

1. Ground-color of wing pale brown or gray, sparsely variegated with darker brown and whitish areas; cell *R* without white areas immediately beyond arculus 2
   Ground-color of wing brown, more conspicuously variegated with whitish, including a large area in cell *R* just beyond arculus 3
2. Wings with the whitish areas restricted to small marks near posterior margin of cell *M* and in cells *1st* M_2 and base of M_3 .... **centralis**
   Whitish wing-pattern more extensive, including areas before and beyond origin of *Rs*, a conspicuous band beyond stigma and anterior cord and a basal area from cell *M* through *1st A* .... **perretti**
3. Wings with a conspicuous brownish area in bases of cells *R* and *M* beyond arculus 4
   Wings with cells *R* and *M* just beyond arculus clear 7
4. Male hypopygium with basistyle armed caudally with a slender spine; tergite pale, the cephalic border of tergal saucer represented by a small median, transverse black elevation; female (known only in *longiventris*), with abdomen greatly elongated 5
   Male hypopygium with basistyle unarmed; tergal saucer more extensively blackened; abdomen of normal length in both sexes 6
5. Antennae (♂) relatively short; flagellum bicolorous, the enlargements black, the remainder yellow; praescutum fawn-colored, the stripes bordered by brown; darkened post-arcular area more extensive .... **longiventris**
   Antennae (♂) more elongated; flagellum unicolorous, dark brown; praescutum dull gray, with four brown stripes; darkened post-arcular area reduced .... **caroliniana**
6. Antennal flagellum distinctly bicolored throughout, the enlargements darkened, the remainder yellow; cell *2nd A* of wings uniformly whitened or with a linear brown discal streak .... **fultonensis**
   Antennal flagellum beyond the basal segments uniformly dark brown; cell *2nd A* of wings more clouded with brown .... **platymera**
7. Wing-pattern very pale, being scarcely darkened along cord; dark pattern restricted to small clouds at origin of *Rs* and in vicinity of stigma; cell R_5 pale at base; cell *1st* M_2 almost uniformly pale .... **serrulata**
   Wing-pattern more developed; cell R_5 darkened at base; cell *1st* M_2 with outer cephalic half darkened 8
8. Antennae dark throughout; flagellum entirely black, the segments (♂) very strongly excised, the outer lobe nearly equal in size to the basal enlargement; abdomen (♀) bluish gray .... **arctica**
   Antennae indistinctly to clearly bicolorous, the flagellar segments less strongly excised; abdomen obscure yellow or brownish yellow, the tergites with a median brown stripe 9

9. Antennae (♂) with flagellar segments slender, very feebly excised; basal enlargements dark, the remainder light yellow; male hypopygium with a strong median tooth near caudal border of the extensive tergal saucer (Fig. 27, A), the latter entirely blackened, with lateral spines; inner dististyle a little expanded and bidentate at apex .... **balioptera**
Antennae (♂) with flagellar segments stouter and more strongly excised; basal enlargements dark brown, the remainder pale brown; male hypopygium with tergite pale, the saucer (Fig. 27, B) very short, without lateral spines, the caudal border with a broad U-shaped notch; inner dististyle (Fig. 27, B) narrow, the apex simple .... **canadensis**

Tipula (*Vestiplex*) **arctica** Curt.
1831. *Tipula arctica* Curtis; Ross's Voyage to the Arctic Regions, p. lxxvii, pl. A, fig. 15.
1838. *T. nodulicornis* Zetterstedt; Ins. Lapponica, Dipt., p. 841.
1848. *T. glomerata* Walker; List Dipt. Brit. Mus., 1:70.

Figs.—Alexander, Rept. Can. Arctic Exped., 1913-18, III, C (Dipt.), figs. 10 (wing), 17 (antenna), 35 (hyp.), 40 (ovipositor); pl. 6 (ad. ♀); 1919.

General coloration, including abdomen of ♀ bluish gray; abdomen of ♂ with tergites more reddish yellow, trivittate with darker. Praescutal interspaces with brown punctures. Wings with cell *R* clear except for spot at origin of *Rs*. Male hypopygium with inner dististyle a narrow arcuate rod, its apex simple. ♂. L. 15-17 mm.; w. 17-18 mm. ♀. L. 21-23 mm.; w. 18-19 mm.

Arctic portions of Eurasia and North America. (Arctic-Alpine).

T. (*Vestiplex*) **balioptera** Lw. (Fig. 27, A).
1863. *Tipula balioptera* Loew; Berlin. Ent. Zeitschr., 7:284.

Figs.—Alexander, Cfls. N. Y., 1, pl. 46, fig. 227 (wing), pl. 50, fig. 279, pl. 54, fig. 337 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 234, fig. 146 (wing), p. 249, fig. 187 (hyp.); 1932.

Readily told by the median spine of tergal saucer (Fig. 27, A). Abdominal tergites brownish yellow, with a conspicuous median brown stripe. ♂. L. 14-15 mm.; w. 14-16.5 mm. ♀ L. 20-22 mm.; w. 16-17 mm.

(Late June, July; Sept., Oct.) Subarctic North America. Ont., Que., Me., westw. to Wisc. and Alta. (Hudsonian).

T. (*Vestiplex*) **canadensis** Lw. (Fig. 27, B).
1864. *Tipula canadensis* Loew; Berlin. Ent. Zeitschr., 8:59.

Fig.—Alexander, Cfls. N. Y., 1, pl. 50, fig. 281, pl. 54, fig. 341 (hyp.); 1919.

Posterior border of tergal saucer of hypopygium (Fig. 27, B) with numerous pale setae on either side of midline. ♂. L. 13-16 mm.; w. 14-16.5 mm.

(June, July) Subarctic North America, southw. to Ont., Que., Labr., westw. to Alta. (Hudsonian).

T. (*Vestiplex*) **caroliniana** Alex.
1916. *Tipula caroliniana* Alexander; Can. Ent., 48:46-48.

Fig.—Alexander, Cfls. N. Y., 1, pl. 50, fig. 286 (hyp.); 1919.

Characters much as in *longiventris*, readily told by the more elongate male antennae, with the pedicels approximately three times as long as the basal enlargement. ♂. L. 18-19 mm.; w. 19-21 mm.

N. C. (Transition).

T. (*Vestiplex*) **centralis** Lw.
1864. *Tipula centralis* Loew; Berlin. Ent. Zeitschr., 8:60.

Figs.—Alexander, Cfls. N. Y., 1, pl. 50, fig. 280, pl. 54, fig. 339 (hyp.); 1919.

Antennae with basal three flagellar segments indistinctly bicolored, the remainder uniformly dark brown. Abdomen orange; a

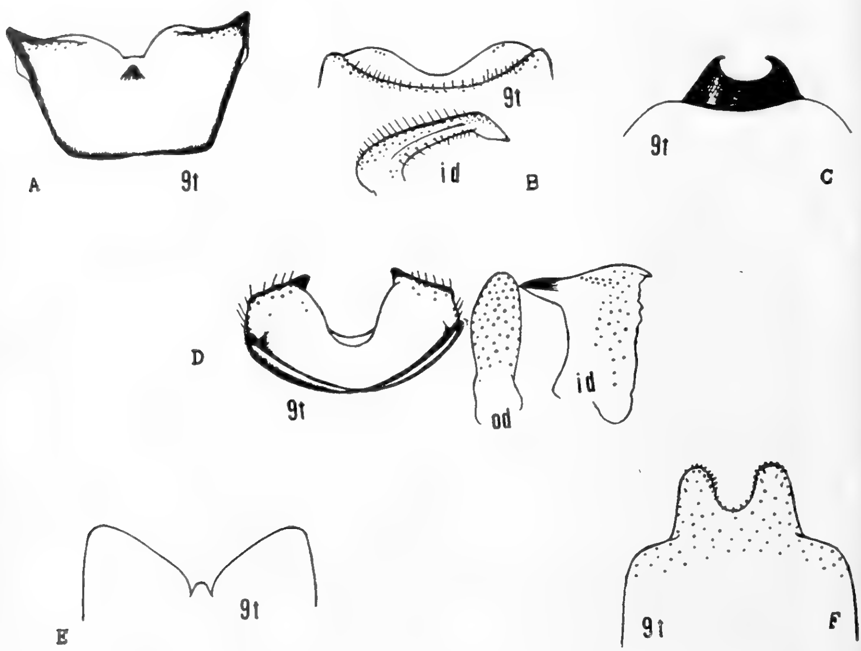


FIGURE 27. *Tipula (Vestiplex, Arctotipula)*, male hypopygia.
A. *T. (V.) balioptera* Lw.; *9t*, dorsal. D. *T. (V.) fultonensis* Alex.; details.
B. *T. (V.) canadensis* Lw.; *9t*, *id*. E. *T. (A.) besselsi* O.S.; *9t*.
C. *T. (V.) perretti* Alex.; *9t*. F. *T. (A.) dickinsoni* Alex.; *9t*.
Symbols: *id*, inner dististyle; *od*, outer dististyle; *t*, tergite.

dorso-median stripe on tergites one to nine, interrupted by pale caudal borders, broader on segments seven to nine and here including most of segments. Male hypopygium with tergite a small black saucer. Outer dististyle relatively large, pale, dilated outwardly, the outer angles distinct to appear somewhat like the blade of an axe. ♀. L. 17 mm.; w. 17.5 mm.

Subarctic North America: Hudson Bay Region; Que., N. H. (Alpine summits), (Hudsonian).

T. (*Vestiplex*) **fultonensis** Alex. (Fig. 27, D).
1918. *Tipula fultonensis* Alexander; Can. Ent., 50: 67.
1920. *T. hinei* Alexander; Ohio Journ. Sci., 20: 200.

Male hypopygium with notch of tergite (Fig. 27, D, *9t*) broadly U-shaped. Outer dististyle, *od*, relatively small, narrowed beyond midlength, the apex obtuse. Inner dististyle, *id*, unusually broad, the posterior edge irregularly serrulate. ♂. L. 16-17 mm.; w. 17.5-19 mm. ♀. L. 21-22 mm.; w. 17-19 mm.

(June-Aug.) Subarctic North America, southw. to Ont., Que., N. B., Me., N. H., Vt., and N. Y., westw. to Alaska. (Hudsonian, Canadian).

T. (*Vestiplex*) **longiventris** Lw.
1863. *Tipula longiventris* Loew; Berlin. Ent. Zeitschr., 7: 278.

Figs.—Alexander, Cfls. N. Y., 1, pl. 46, fig. 229 (wing), pl. 50, fig. 285 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 234, fig. 147 (wing), p. 249, fig. 182 (hyp.); 1932.

Most readily told by the structure of the male hypopygium and the unusual length of the abdomen in the female. ♂. L. 15-17 mm.; w. 18-20 mm. ♀. L. 30-35 mm.; w. 20-21 mm.; abdomen alone 26-30 mm.

(Late May-early July) Ont., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Mich., Ill., Wisc., southw. to S. C. and Tex. (Canadian, Transition).

Connecticut. — Hamden, June 14, 1916 (H. L.); Manitic Lake, June 8-9, 1929 (C. P. A.); Montville, June 12, 1929 (W. E. B.); Riverton, June 12, 1931 (C. P. A.); Rowayton, June 16, 1909 (C. W. J.); Stamford, June 17, 1929, June 1, 1930 (B. T. R. L.); Storrs, May 1928, 1929; Tolland, June 23, 1932 (N. T.); Tunxis State Park, June 12, 1931 (C. P. A.).

T. (*Vestiplex*) **perretti** Alex. (Fig. 27, C).
1928. *Tipula perretti* Alexander; Can. Ent., 60: 98-99.

Antennae with flagellar segments indistinctly bicolorous, dark brown, the basal enlargements black. Abdomen bright orange, the basal six tergites narrowly trivittate with brownish black. Male hypopygium with the tergite (Fig. 27, C) appearing as a thin flattened plate that represents the usual cephalic border of the tergal saucer, the caudal margin of this plate with a broad U-shaped notch, the lateral angles decurved into triangular points. ♂. L. 13.5 mm.; w. 14.3 mm.

(July) Subarctic North America: Lab. (Hudsonian).

T. (*Vestiplex*) **platymera** Wk.
1856. *Tipula platymera* Walker; Ins. Saundersiana, 1, Dipt.: 441.
1863. *T. tesselata* Loew; Berlin. Ent. Zeitschr., 7: 277-278; ♀.
1863. *T. septentrionalis* Loew; *Ibid.*, 7: 278; ♂.
1915. *T. labradorica* Alexander; Insec. Inscit. Menst., 3: 128.

Figs.—Alexander, Cfls. N. Y., 1, pl. 46, fig. 228 (wing, ♀), pl. 50, fig. 283, pl. 54, fig. 338 (hyp.); 1919.

Wing-pattern of female much more tesselated and contrasted than in male. Male hypopygium much as in *fultonensis*, but cephalic

border of tergal saucer high and elevated, more or less notched medially. Inner dististyle even broader, the outer caudal angle strongly produced. ♂. L. 15-17 mm.; w. 16-19 mm. ♀. L. 23-25 mm.; w. 18-20 mm.

(June, July) Arctic and Subarctic North America, southw. to mts. of Ont., Que., N. B., N. H., Vt. and N. Y. (Hudsonian, Canadian).

T. (*Vestiplex*) **serrulata** Lw.
1864. *Tipula serrulata* Loew; Berlin. Ent. Zeitschr., 8:58.

Still known only from the unique type female but apparently representing a species distinct from either *balioptera* or *canadensis*, the near allies. ♀. L. 25 mm.; w. 20.5 mm.

Subarctic North America: Hudson Bay Region. (Hudsonian).

Subgenus **Arctotipula** Alexander

1933. *Arctotipula* Alexander; Philippine Journ. Sci., 52:410-411.

Distinguished from *Vestiplex* chiefly by the long, pale body vestiture, the unusually glabrous nature of the wing-veins, and the structure of the ovipositor, the cerci being abruptly narrower than the remainder of abdomen, pale and without serrations.

Nasus present or lacking. Squama naked. Male hypopygium with tergite and sternite separate. *Tipula dickinsoni* is referred here with some doubt.

Key to Species

1. Wings tinged with brown, stigma relatively inconspicuous; *m-cu* uniting with M_{3+4} at or before midlength; male hypopygium with tergite produced into a median lobe (Fig. 27, F) .... **dickinsoni**
   Wings subhyaline, the stigma dark brown, conspicuous; *m-cu* uniting with M_4 just beyond base; male hypopygium (unknown in *piliceps*) with tergite notched medially (Fig. 27, E); Arctic and Subarctic species 2
2. Coloration of praescutum blue-gray, with four darker, in cases nearly black, stripes, the intermediate pair tending to be confluent; a median vitta on vertex; median stripe on abdominal tergites broad; female with eighth tergite not conspicuously expanded; cerci small .... **besselsi**
   Coloration of praescutum dull light gray, with four light brown stripes; median vitta on vertex indistinct; median stripe on abdominal tergites narrow; female with eighth tergite flattened and expanded; cerci long, pale .... **piliceps**

Tipula (*Arctotipula*) **besselsi** O. S. (Fig. 27, E).
1876. *Tipula besselsi* Osten Sacken; Proc. Boston Soc. Nat. Hist., 19:42.

Antennae black throughout. Nasus lacking. Coloration of body blue-gray; lateral borders of abdominal tergites paler. Conspicuous erect pale setae on head, thoracic interspaces, sternopleurite and all coxae. Ninth tergite (Fig. 27, E): sketch of type by Nathan Banks. ♂. L. 11-12 mm.; w. 13-14 mm.; antenna, about 4-4.2 mm.

(July) Arctic North America, Greenland to Alaska.

T. (*Arctotipula*) **dickinsoni** Alex. (Fig. 27, F).
1932. *Tipula dickinsoni* Alexander; Bull. Publ. Mus. Milwaukee, 8: 240-242.

Figs.—*Ibid.*, p. 251, figs. 197 (wing, hyp.), by Dickinson.

Nasus elongate. Antennal flagellum with basal segments bicolorous, black, the basal enlargements dull yellow, the outer segments uniformly blackened. General coloration of notum brown; praescutum with darker brown stripes, the lateral pair more or less obsolete; pleura and coxae blue-gray. Vestiture of body relatively short and inconspicuous, lacking on sternopleurite. Hypopygium with tergite (Fig. 27, F). ♂. L. 12-13 mm.; w. 12.5-13 mm.; antenna, 4.5-4.8 mm. ♀. L. 13-13.5 mm.; w. 11-11.5 mm.

(Late May) Mich., in grass-sedge-cattail marshes; Wisc., in tamarack bog. (Canadian).

T. (*Arctotipula*) **piliceps** Alex.
1915. *Tipula piliceps* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 482-484.

Fig.—Alexander, *Ibid.*, pl. 21, fig. 85 (ovipos.).

The essential characters are given in the key. ♀. L. 14.5 mm.; w. 16 mm.

Subarctic North America.

Subgenus **Yamatotipula** Matsumura

1916. *Yamatotipula* Matsumura; Thousand Ins. Japan, Add. 2: 461-462.

Rs long, nearly if not quite twice *m-cu*, in extreme cases even longer; *m-cu* usually close to base of cell *1st* M_2, M_{3+4} being short to very short; second section of M_{1+2} and basal section of M_3 often parallel to one another but the latter usually shortened by the length and obliquity of *m*. Squama naked; outer branches of *M* with macrotrichia. Tibial spur-formula 1-1-2 or 1-2-2; claws (♂) toothed. Male hypopygium strongly compressed, the tergite and sternite fused into a continuous ring; median region of tergite produced caudad into a simple or bifid depressed lobe, the apical margin of which is set with small blackened spines. Gonapophyses usually appearing as pale spatulate blades; a single or double tuft of yellow setae jutting from the notch of the ninth sternite.

Includes all members of the so-called "Vittatae" (the *tricolor* or *lateralis* group), having the wings striped longitudinally with brown and white. A few species are included that have the wings clear or nearly so and with *m-cu* slightly more distad in position (*tephrocephala*), such forms apparently being consubgeneric. The most aberrant species is *iroquois*, which has the tergite rather distinctly separated from the sternite. *Tipula dickinsoni* has a depressed tergal lobe that is very suggestive of members of this subgenus, but from other characters is referred to another subgenus (*Arctotipula*).

Key to Species

1. Wings longitudinally striped with brown and whitish, the pattern tending to become obsolete or dilute in certain species; a dark seam on veins *Cu* and *m-cu* (*Vittatae*) 2
   Wings unmarked except for the stigmal darkening and a yellowish to brown costal border, or else (*iroquois*) with the apex of wing irregularly darkened; no dark seam on veins *Cu* and *m-cu* 17
2. Antennae with the scape and pedicel darkened, the flagellum uniformly light yellow throughout .... **manahatta**
   Antennae with the flagellum not uniformly yellow 3
3. Wings with at least the outer portion of cell R_5 white, the area nearly if not quite continuous with the pale central area in cell *M* 4
   Wings with the cells beyond cord, including R_5, darkened; (in some *fraterna*, the outer end of cell R_5 is pale but the area is isolated by dark color beyond cord) 12
4. Antennae with outer flagellar segments uniformly dark brown, the more basal ones yellowish brown 5
   Antennae with the flagellar segments bicolorous, yellow, the bases darkened 6
5. Size large (wing, ♂, over 20 mm.); wing-pattern heavily contrasted; cell *R* chiefly dark brown, cell *M* abruptly pale; stigma yellowish; male hypopygium with median tergal lobe narrow, subtended on either side by lateral claws (Fig. 28, M) .... **noveboracensis**
   Size smaller (wing, ♂, 16 mm. or less); wing-pattern pale and diffuse, cells *R* and *M* chiefly pale; stigma brown; male hypopygium with median tergal lobe broad, without lateral armature .... **vicina**
6. Wings with bases of cells M_1 and *2nd* M_2 pale; cell *R* immediately before origin of *Rs* not conspicuously pale, this color being confined to outer end of cell 7
   Wings with cells M_1 and *2nd* M_2 uniformly darkened; cell *R* with invasion of pale coloration before origin of *Rs* 10
7. Abdomen ochre-yellow, without lateral brown stripes; cell *1st* M_2 entirely pale .... **conspicua**
   Abdomen with conspicuous brown sublateral stripes on tergites; cell *1st* M_2 with outer half or more darkened 8
8. Antennae (♂) short, if bent backward not attaining wing-root; basal half of cell *M* or nearly so dark brown .... **caloptera**
   Antennae (♂) longer, if bent backward extending to mid-distance between roots of wings and halteres; cell *M* with only the basal fourth or fifth darkened 9
9. Wing-pattern pale and diffuse, not strongly contrasting; vein *2nd A* not or only weakly bordered by brown .... **strepens**
   Wing-pattern strongly contrasted; vein *2nd A*, except at base, margined with brown .... **calopteroides**
10. Wings with the dark and light pattern contrasted, the white coloration in cell *R* more extensive, reaching vein *R* or nearly so before the origin of *Rs*, the dark costal border thus with its posterior margin appearing bisinuate .... **furca**
    Wings with the dark pattern more diffuse and less contrasted, not so conspicuously invading cell *R* before origin of *Rs* and the dark costal stripe not appearing bisinuate 11
11. Cell *1st* M_2 entirely clear, the pale area in cells *R* and *M* thus continued uninterrupted to wing-tip; male hypopygium with apex of median lobe of tergite convexly rounded .... **eluta**
    Cell *1st* M_2 with more than apical half darkened, separating the pale area in cell *M* from that in cell R_5; male hypopygium with apex of median lobe of tergite gently concave (Fig. 28, D) .... **concava**
12. Wings with a conspicuous whitish crossband at cord, reaching the posterior margin of wing in cells M_3 and M_4 .... **fraterna**
    Wings with the whitish crossband at cord less extensive, extending through cell *1st* M_2 or only slightly beyond 13

13. Thoracic pleura with a transverse dark brown stripe involving the cephalic portions of the anepisternum and sternopleurite .... **subeluta**
    Thoracic pleura unmarked 14
14. Wings very poorly marked with whitish, the pale areas in cell *M* and at the cord ill-defined to almost obsolete; veins brown, contrasting with the ground-color; male hypopygium with the tergal lobe at apex shallowly bifid (Fig. 28, K) .... **kennicotti**
    Wings with central portion of disk conspicuously brightened; veins yellow; male hypopygium with the tergal lobe obtuse, entire 15
15. Abdominal tergites with dark sublateral stripes .... **vitrea**
    Abdominal tergites without stripes 16
16. Coloration of thorax and abdomen reddish brown, the terminal abdominal segments scarcely darkened; male hypopygium without a pencil of setae on either side of median lobe of tergite .... **sackeniana**
    Coloration more grayish, praescutal stripes brownish gray; outer abdominal segments extensively infuscated; male hypopygium with a pencil of long setae on either side of median lobe of tergite .... **tricolor**
17. Antennae with basal enlargements of flagellar segments light yellow, the remainder dark brown or black .... **tephrocephala**
    Antennae with the flagellum uniformly darkened, or, if bicolorous, the basal enlargements of the individual segments dark, the remainder paler 18
18. Costal border of wings dark brown, the color involving the cephalic border of cell *R* and all of cells R_1 and Sc_2 .... **sayi**
    Costal border of wings only moderately if at all darkened, the coloration yellowish to brownish yellow, including cells *C* and *Sc* but not passing caudad beyond level of vein *R* 19
19. Wing-apex darkened .... **iroquois**
    Wing-apex clear 20
20. Antennal flagellum bicolorous; size large (wing, ♂, over 16 mm.) 21
    Antennal flagellum uniformly blackened; size smaller (wing, ♂, under 14 mm.) 22
21. Stigma brown, conspicuously darker than the yellowish costal border; veins dark brown, conspicuous; male hypopygium with the tergite dark, terminating in two slender yellow finger-like lobes (Fig. 28, C) .... **cayuga**
    Stigma pale brownish yellow, concolorous with the costal border; veins pale, yellowish or brownish yellow, inconspicuous against the ground; male hypopygium with the tergite terminating in an obtuse median black lobe (Fig. 28, J) .... **jacobus**
22. Abdomen gray, the tergites more brownish medially; antennae black throughout 23
    Abdomen brownish yellow to obscure orange, at least basally; antennae with basal segments yellowish 24
23. Male hypopygium with caudal margin of tergite bearing four lobes, there being two parallel submedian ones between the lateral divergent pair (Fig. 28, A) .... **aprilina**
    Male hypopygium with caudal margin of tergite bearing two divergent lobes, usually with a low rounded tubercle between (Fig. 28, E) .... **dejecta**
24. Scutellum and postnotum gray, concolorous with the thoracic pleura; male hypopygium with caudal margin of tergite with three low lobes, the laterals fully as high as the very broad median lobe (Fig. 28, H) .... **grenfelli**
    Scutellum and postnotum, including pleurotergite, light sulphur-yellow, contrasting abruptly with the light gray pleura; male hypopygium with caudal margin of tergite terminating in two submedian lobes (Fig. 28, O) **sulphurea**

Tipula (*Yamatotipula*) **aprilina** Alex. (Fig. 28, A).
1918. *Tipula aprilina* Alexander; Can. Ent., 50: 63-64.

Male hypopygium with tergite (Fig. 28, A) large, reddish brown; lateral lobes blackened, with microscopic tubercles: submedian lobes

slightly longer, more pointed, directed slightly ventrad. ♂. L. 9-11 mm.; w. 10-11.5 mm. ♀. L. 12-13 mm.; w. 11 mm.

(Apr., May) Mass., southw. to Va., N. C. and S. C. (Transition, Austral).

Connecticut.—Branford, May 12, 1933 (M. P. Z.); Storrs, April 1932, May 23, 1929 (J. A. M.).

T. (*Yamatotipula*) **caloptera** Lw. (Fig. 28, B).
1863. *Tipula caloptera* Loew; Berlin. Ent. Zeitschr., 7:292.

Figs.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 214 (wing); 1919. Dickinson, Cfls. Wisc., p. 228, fig. 131 (wing); 1932.

Praescutal stripes narrowly but conspicuously bordered by dark brown. Vein *2nd A* seamed with brown. Male hypopygium with median lobe of tergite (Fig. 28, B) very broad, obtuse, not subtended by lobes or hair-pencils. ♂. L. 18-22 mm.; w. 22-26 mm. ♀. L. 25-26 mm.; w. 26-28 mm.

(June-Aug.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Wisc. and Mo., southw. to n. Fla. and Tenn.

Connecticut.—Cornwall Bridge, June 12, 1931 (M. M. A.); East River, June 12 (Ely); Kent Falls, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Stamford, July 17, 1929 (B. T. R. L.); Storrs, 1929 (C. S. C.).

T. (*Yamatotipula*) **calopteroides** Alex.
1919. *Tipula calopteroides* Alexander; Can. Ent., 51:168-169.
1921. *T. antiopa* Dietz; Trans. Amer. Ent. Soc., 47:266-267.

Close to *strepens* and possibly only a darker southern race of same, distinguished by the larger size and more intense pattern of the wings, which are almost as dark in color as in *caloptera*. ♂. L. 17-17.5 mm.; w. 21-22 mm. ♀. L. about 25 mm.; w. 25-25.5 mm.

(May, June) Pa., southw. to N. C. and S. C.

T. (*Yamatotipula*) **cayuga** Alex. (Fig. 28, C).
1915. *Tipula cayuga* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:485-487.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 10 (wing), pl. 19, fig. 49, pl. 20, fig. 63 (hyp.). Alexander, Cfls. N. Y., 1, pl. 46, fig. 222 (wing), pl. 49, fig. 272, pl. 53, fig. 325 (hyp.); 1919.

Praescutum olive gray, the stripes reddish brown, bordered by dark brown. The structure of the hypopygium shows an obvious relationship to *tephrocephala*; ninth tergite (Fig. 28, C). ♂. L. 15-18 mm.; w. 16.5-18.5 mm. ♀. L. 23-24 mm.; w. 21-22 mm.

(Late May, June) Ont., N. B., N. S., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to Tenn.

Connecticut.—Cornwall Bridge, May 30, 1931, June 13, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

T. (*Yamatotipula*) **concava** Alex. (Fig. 28, D).
1926. *Tipula concava* Alexander; Ent. News, 37: 294-295.

Male hypopygium, tergite (Fig. 28, D). ♂. L. 12.5-13 mm.; w. 12-13.5 mm.

(June-Aug.) Ct., westw. to Mich., Ind. and Mo., southw. to Tenn. (Transition).

Connecticut.—Cornwall Bridge, June 12, 1931 (C. P. A.); Winnipauk, June 16, 1909 (C. W. J.), recorded by Johnson (1925:36) as *eluta*.

T. (*Yamatotipula*) **conspicua** Dtz.
1917. *Tipula conspicua* Dietz; Ent. News, 28: 149-150.

Figs.—Dietz, *Ibid.*, pl. 11, fig. 2 (wing, hyp.).

Male hypopygium with caudal margin of tergite extended into a cone, at base of which, on either side, with a small inconspicuous pencil of setae. ♂. L. 15.5 mm.; w. 17 mm.

(Sept.) N. C.

T. (*Yamatotipula*) **dejecta** Wk. (Fig. 28, E).
1856. *Tipula dejecta* Walker; Ins. Saundersiana, 1, Dipt., p. 442.
1901. *T. fumosa* Doane; Journ. N. Y. Ent. Soc., 9: 99-100.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 12, figs. 64, 65 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 48, fig. 251 (wing), pl. 51, fig. 301 (hyp.); 1919.

General coloration gray, the pleura clear gray; praescutal stripes brown or grayish brown, narrowly bordered by darker. Wings weakly infumed; stigma brown. Ninth tergite (Fig. 28, E): ventral face of each lobe with an acute blackened tooth. ♂. L. 8-10 mm.; w. 9.5-12 mm. ♀. L. 10-12 mm.; w. 8-12 mm.

(Apr.-June) Ont., Que., N. H., Mass., R. I., N. Y., N. J., Pa., westw. to Ind., Ill. and Mich., southw. to Md. and Va.

Connecticut.—N. Branford, May 12, 1933 (M. P. Z.); Riverton, May 17, 1931 (C. P. A.); Salisbury, May 16, 1931 (C. P. A.); Storrs, May, 1928, 1929 (C. S. C.); Tyler Lake, May 17, 1931 (C. P. A.); Westville, May 16, 1904 (W. E. B.).

T. (*Yamatotipula*) **eluta** Lw.
1863. *Tipula eluta* Loew; Berlin. Ent. Zeitschr., 7: 290.

Fig.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 217 (wing); 1919.

♂. L. 12-13 mm.; w. 12.5-13 mm. ♀. L. 14 mm.; w. 14-15 mm.

(July, Aug.) Ont., Que., N. B., N. H., Vt., Mass., N. Y., Pa., westw. to Ill., southw. to n. Fla. and Tenn.

Connecticut.—Branford, Aug. 24, 1904 (P. L. B.), Aug. 1905 (H. W. W.); Storrs, 1932 (C. S. C.). (Johnson's record for *eluta*, 1925: 36, refers to *concava* Alex.).

T. (*Yamatotipula*) **fraterna** Lw. (Fig. 28, F).
1864. *Tipula fraterna* Loew; Berlin. Ent. Zeitschr., 8: 56.

Antennae relatively long, bicolorous. Specimens sometimes occur that have the outer end of cell R_5 whitish, this area widely separated from the pale band at cord by dark color in cells R_5 to *2nd* M_2.

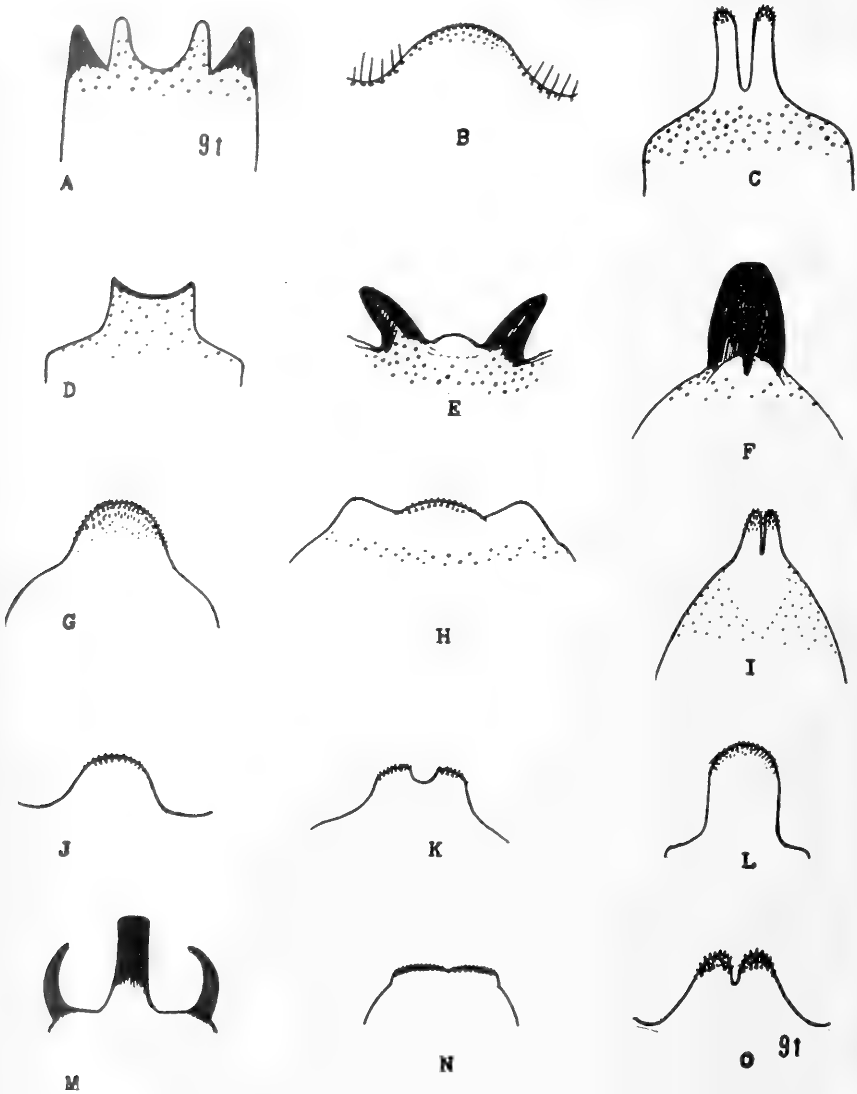


FIGURE 28. *Tipula* (*Yamatotipula*); male hypopygia, 9th tergite.

A. *T.* *(Y.)* *aprilina* Alex.
B. *T.* *(Y.)* *caloptera* Lw.
C. *T.* *(Y.)* *cayuga* Alex.
D. *T.* *(Y.)* *concava* Alex.
E. *T.* *(Y.)* *dejecta* Walk.
F. *T.* *(Y.)* *fraterna* Lw.
G. *T.* *(Y.)* *furca* Walk.
H. *T.* *(Y.)* *grenfelli* Alex.
I. *T.* *(Y.)* *iroquois* Alex.
J. *T.* *(Y.)* *jacobus* Alex.
K. *T.* *(Y.)* *kennicotti* Alex.
L. *T.* *(Y.)* *manahatta* Alex.
M. *T.* *(Y.)* *noveboracensis* Alex.
N. *T.* *(Y.)* *sayi* Alex.
O. *T.* *(Y.)* *sulphurea* Doane.

Symbol: *t*, tergite.

Male hypopygium with median lobe of tergite (Fig. 28, F) elongate, obtuse and subtruncate at apex. ♂. L. 14-15 mm.; w. 15-16 mm. ♀. L. 18-20 mm.; w. 17-17.5 mm.

(June, July) N. H., Ct., Pa., southw. to N. C., S. C., Ga. and n. Fla. (Transition, Austral).

Connecticut.—Cornwall Bridge, June 12, 1931 (C. P. A.); Farmington, June 29 (W. M.); Norwalk, July 9, 1916 (I. N. G.).

T. (*Yamatotipula*) **furca** Wk. (Fig. 28, G).
1848. *Tipula furca* Walker; List Dipt. Brit. Mus., 1:70.
1863. *T. bella* Loew; Berlin. Ent. Zeitschr., 7:291.

Figs.—Snodgrass, Journ. N. Y. Ent. Soc., 11, pl. 10, fig. 6 (ovipos.); 1903. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 16, figs. 123-127 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 45, fig. 216 (wing), pl. 49, fig. 265 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 228, fig. 130 (wing), p. 248, fig. 165 (hyp.); 1932.

Antennae (♂) relatively short, if bent backward about attaining wing-root. Cell *1st* M_2 entirely pale. Male hypopygium with tergal lobe (Fig. 28, G) relatively short and broad, obtuse, the margin with blackened spines. ♂. L. 13-14 mm.; w. 15-16 mm. ♀. L. 16-18 mm.; w. 16-18 mm.

(May-Sept.) Ont., Que., Me., N. H., Mass., R. I., N. Y., Pa., westw. to Wisc., Ia., Mo. and Kan., southw. to n. Fla., La. and Tex.

Connecticut.—Branford, Aug. 11, 1904 (H. L. V.), Aug. 24, 1904 (P. L. B.) May 12, 1933 (M. P. Z.); Farmington, May 16, 1933 (M. P. Z.); Kent Falls, May 17, 1931 (C. P. A.), Aug. 19, 1931 (C. P. A.); Middletown, May 26, 1929 (R. C. N.); Mt. Carmel, Aug. 27, 1904 (P. L. B.); New Haven, May 31, 1929 (R. B. F.), Oct. 19, 1913 (L. B. R.); Norfolk, June 9, 1929 (C. P. A.); Oxford, May 21, 1904 (W. E. B.); Riverton, June 8, 1929 (C. P. A.); Salisbury, Aug. 30, 1904 (W. E. B.); Storrs, May 17, 1920 (J. A. M.), May 22, 1929 (K. W.); Wallingford, Aug. 13, 1922 (S. W. B.); Windsor, June 19, 1905 (W. E. B.); Connecticut, without more accurate data, Norton, Loew's type of *bella,* Mus. Comp. Zool., No. 99.

T. (*Yamatotipula*) **grenfelli** Alex. (Fig. 28, H).
1928. *Tipula grenfelli* Alexander; Can. Ent., 60:96-97.

Antennae (♂) relatively long, if bent backward extending to beyond base of abdomen; flagellar segments feebly excised. Basal abdominal tergites orange, darker sublaterally. Male hypopygium with tergite (Fig. 28, H). ♂. L. 12.5-14 mm.; w. 13-13.8 mm.; antenna, about 5 mm.

(June-July) Lab. (Hudsonian).

T. (*Yamatotipula*) **iroquois** Alex. (Fig. 28, I).
1863. *Tipula cincta* Loew; Berlin. Ent. Zeitschr., 7:288 (preoccupied).
1915. *T. iroquois* Alexander; Insec. Inscit. Menst., 3:128.

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 252 (wing), pl. 51, fig. 300, pl. 54, fig. 344 (hyp.); 1919.

Antennae uniformly blackened. Praescutum light gray, with four slightly darker gray stripes that are narrowly bordered by

brown. Abdomen dark brown, the posterior borders of tergites pale. Male hypopygium with tergite more evidently separated from sternite than usual in subgenus; outer dististyle long and slender, narrowed to a point. Tergite (Fig. 28, I) long, narrowed outwardly, terminating in two slender lobes that lie close together. ♂. L. 9-11 mm.; w. 11-13 mm. ♀. L. 12-14 mm.; w. 13-15 mm.

(May, June) Me., N. H., Mass., N. Y., N. J., Pa., Va., N. C. and Tenn. (Canadian, high Transition). Along rapidly flowing mountain streams with mossy boulders; larva presumably aquatic in moss.

Connecticut.—Kent Falls, May 17, 1931 (C. P. A.), May 30-31, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, May 16, 1931 (C. P. A.), May 30, 1931 (C. P. A.); Winsted, May 16, 1931 (C. P. A.).

T. (*Yamatotipula*) **jacobus** Alex. (Figs. 22, A, B; 28, J).

1909. *Tipula perlongipes* Johnson; Proc. Boston Soc. Nat. Hist., 34: 131 (new name for *T. filipes* Walker, preoccupied, but based on mis-determination of latter).

1930. *T. jacobus* Alexander; Bull. Brooklyn Ent. Soc., 25: 277.

Figs.—Alexander, Cfls. N. Y., 1, pl. 46, fig. 223 (wing), pl. 49, fig. 268 (hyp.); 1919.

Praescutal stripes conspicuously bordered by brown. Pleura clear gray pruinose. Legs very long. Male hypopygium with tergal lobe (Fig. 28, J). ♂. L. 17-20 mm.; w. 17-21 mm.

(June, July) Mass., R. I., N. Y., N. J., Pa., southw. to n. Fla., Ga. and Tenn. (Transition, Austral).

Connecticut.—Union, June 24, 1932 (N. T.).

T. (*Yamatotipula*) **kennicotti** Alex. (Fig. 28, K).

1915. *Tipula kennicotti* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1915: 480-482.

1926. *T. parvemarginata* Alexander; Ent. News, 37: 295-297.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1915, pl. 16, fig. 6 (wing), pl. 18, fig. 34, pl. 19, fig. 48 (hyp.); 1915. Alexander, Cfls. N. Y., 1, pl. 46, fig. 224 (wing), pl. 49, fig. 269, pl. 53, fig. 331 (hyp.); 1919.

Antennal flagellum dark brown, proximal ends of segments sometimes a little paler. Praescutal stripes margined with brown, including a persistent median vitta. Wing-pattern almost obsolete. Male hypopygium with tergal lobe (Fig. 28, K). ♂. L. 12-13 mm.; w. 12.5-14 mm. ♀. L. 14-15 mm.; w. 15-16 mm.

(June-Aug.) Man., Ind., Minn., Mich., westw. to N. Dak. and Alta.

T. (*Yamatotipula*) **manahatta** Alex. (Fig. 28, L).

1919. *Tipula manahatta* Alexander; Can. Ent., 51: 169-170.

Coloration reddish brown, pleura very faintly pruinose. Wings broad, rich reddish brown, centers of the cells paler, more grayish; cells beyond cord not or scarcely brightened; obliterative areas at cord restricted and interrupted. Abdomen without stripes. Male hypopygium with median tergal lobe (Fig. 28, L) relatively long, apex obtuse, simple. ♂. L. 15-16 mm.; w. 15-16 mm.

(Aug., Sept.) N. Y., southw. to Tenn. and n. Fla. (Austral).

T. (*Yamatotipula*) **noveboracensis** Alex. (Fig. 28, M).
1919. *Tipula noveboracensis* Alexander; Can. Ent., 51: 167-168.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 16, figs. 128-131 (hyp., as *caloptera*): 1904. Alexander, Cfls. N. Y., 1, pl. 49, fig. 267 (hyp., as *caloptera*); 1919.

Antennae (♂) short, if bent backward ending some distance before wing-root. Wings long and narrow; cells *C* and *Sc* yellowish. Abdominal stripes conspicuous. Male hypopygium with tergite (Fig. 28, M). ♂. L. 18-22 mm.; w. 21-25 mm. ♀. L. 25-27 mm.; w. 24-26 mm.

(May-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to Md. (Canadian).

Connecticut.—Norfolk, May 31, 1931, June 9, 1929 (C. P. A.).

T. (*Yamatotipula*) **sackeniana** Alex.
1918. *Tipula sackeniana* Alexander; Can. Ent., 50: 62-63.

Close to *tricolor*, most readily distinguished by the lack of pencils of setae on the tergite of the male hypopygium. Antennae relatively long, bicolorous. ♂. L. 16.5-18 mm.; w. 15-16 mm. ♀. L. 18-19 mm.; w. 17-17.5 mm.

(July-Sept.) Ct. and N. Y., southw. to Ga. and Tenn.

Connecticut.—Salisbury, Sept. 12, 1928 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.).

T. (*Yamatotipula*) **sayi** Alex. (Fig. 28, N).
1823. *Tipula costalis* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 23 (preoccupied).
1911. *T. sayi* Alexander; Psyche, 18: 194.

Figs.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 219 (wing), pl. 49, fig. 266 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 229, fig. 135 (wing), p. 248, fig. 169 (hyp.); 1932.

Antennae strongly bicolored. Disk of praescutum, including interspaces, brown; lateral and cephalic borders broadly light gray. Male hypopygium with median lobe of tergite (Fig. 28, N) broad and low, truncate or barely bifid. ♂. L. 12-15 mm.; w. 11-17 mm. ♀. L. 16-17 mm.; w. 16-17 mm.

(July-Oct.) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Mich., Wisc., Ia. and Ark., southw. to n. Fla. and La.

Connecticut.—Branford, Sept. 3, 1904 (H. L. V.); East River, Sept. 10 (Ely); Union, Aug. 17-18, 1928 (C. F. C.); Windsor, Aug. 6, 1929 (C. P. A.).

T. (*Yamatotipula*) **strepens** Lw.
1863. *Tipula strepens* Loew; Berlin. Ent. Zeitschr., 7: 291.

Figs.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 215 (wing), pl. 49, fig. 264 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 229, fig. 132 (wing), p. 248, fig. 166 (hyp.); 1932.

Antennal flagellum in cases only weakly bicolorous. Wing-pattern relatively pale and diffuse, without dark seam on vein *2nd A*. ♂. L. 14-16 mm.; w. 19-22 mm. ♀. L. 19-20 mm.; w. 19-20 mm.

(May-July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc., Mich. and Kan.

Connecticut.—Cornwall Bridge, June 12-13, 1931 (C. P. A.); Danbury, June 14, 1904 (C. W. J.); Hamden, June 2, 1928 (R. B. F.); New Haven, July 14, 1911 (A. B. C.); Manitic Lake, June 8-9, 1929 (C. P. A.); Stamford, May 20, 1929 (B. T. R. L.); Storrs, May 1929 (G. H. G.).

T. (*Yamatotipula*) **subeluta** Johns.
1913. *Tipula subeluta* Johnson; Bull. Amer. Mus. Nat. Hist., 32: 42-43.

Allied to *tricolor*. Antennae long, bicolorous. Wings with outer end of cell *M* darkened, separating the pale area in cell *M* from that at cord. Male hypopygium with tergal lobe relatively broad, its apex simple obtuse. ♂. L. 13-14 mm.; w. 15-16.5 mm. ♀. L. 16-18 mm.; w. 15.5-17 mm.

(Aug., Sept.) Mass. (Nantucket Isl.), southw. to Fla. (Austral).

T. (*Yamatotipula*) **sulphurea** Doane. (Fig. 28, O).
1901. *Tipula sulphurea* Doane; Journ. N. Y. Ent. Soc., 9:99.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 12, fig. 66 (hyp.); 1904. Alexander. Cfls. N. Y., 1, pl. 46, fig. 225 (wing), pl. 49, fig. 270 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 236, fig. 154 (wing), p. 250, fig. 189 (hyp.); 1932.

Antennae (♂) elongate, if bent backward extending to opposite the 2nd abdominal segment. Sublateral dark abdominal stripes conspicuous. Male hypopygium with tergal lobe (Fig. 28, O). ♂. L. 12-13 mm.; w. 11-12 mm. ♀. L. 14-15 mm.; w. 12-13.5 mm.

(May-Aug.) Ont., Que., N. B., Me., Mass., R. I., N. Y., westw. to Ind., Mich., Wisc., Minn., Man., Sask. and Alta. (Canadian).

Connecticut.—Norfolk, June 9, 1929 (C. P. A.).

T. (*Yamatotipula*) **tephrocephala** Lw.
1864. *Tipula tephrocephala* Loew; Berlin. Ent. Zeitschr., 8:62.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 15, figs. 118, 120, 122 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 46, fig. 221 (wing), pl. 49, fig. 271 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 236, fig. 153 (wing), p. 249, fig. 186 (hyp.); 1932.

Readily told from all other members of the subgenus by the pattern of the antennae. The only other regional species of this genus having such a reversal of normal pattern are *T. dickinsoni* and *T. flavibasis*, belonging to other subgeneric groups. Lobes of tergite almost as in *cayuga* but somewhat longer and more divergent. ♂. L. 14-18 mm.; w. 16-18.5 mm.

(May-early August) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., Pa., westw. to Ind., Mich. and Wisc.

Connecticut.—Avon, June 14, 1929 (R. B. F.); Canaan, June 10, 1928 (R. B. F.); Danbury, June 15, 1909 (C. W. J.); East River, Aug. 1912 (Ely); Granby, June 8, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Montville, June 12, 1929 (R. B. F.); Putnam, June 15, 1933 (C. P. A.); Rowayton, June 16, 1910 (C. W. J.); Storrs, June 27, 1927 (C. C. G.), 1926, 1932 (R. C. N.), May 27, 1933; Tyler Lake, June 13, 1931 (C. P. A.).

T. (*Yamatotipula*) **tricolor** Fabr. (Fig. 23, A).
1794. *Tipula tricolor* Fabricius; Ent. Syst., 4:235.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 15, figs. 119, 121 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 45, fig. 218 (wing), pl. 49, fig. 263 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 229, fig. 133 (wing), p. 248, fig. 167 (hyp.); 1932.

Antennae strongly bicolorous. Male hypopygium with median lobe of tergite subtended by a pencil of long reddish setae that are nearly twice as long as the lobe itself. ♂. L. 17-18 mm.; w. 17-19 mm. ♀. L. 21-22 mm.; w. 17-20 mm.

(May-Sept.) Ont., Mass., N. Y., N. J., Pa., westw. to Ill., Wisc. and Ark., southw. to Fla., Ga., Ala. and Tenn.

Connecticut.—Chapinville, Aug. 27, 1904 (W. E. B.); East River, Aug. 24, 1910 (Ely); Hamden, June 2, 5, 6, 28, 1929 (R. B. F.); Middlebury, Aug. 10, 1928 (R. B. F.); New Haven, July 14, 1911 (A. B. C.); N. Haven, Aug. 2, 1905 (H. L. V.); Ridgefield, July 19, 1910; Storrs.

T. (*Yamatotipula*) **vicina** Dtz.
1917. *Tipula vicina* Dietz; Ent. News, 28:148-149.

Fig.—Dietz, *Ibid.*, pl. 11, fig. 2 (wing, hyp.).

Male hypopygium with median tergal lobe entire, broad, with indications of weak lateral shoulders. ♂. L. 11.5-13 mm.; w. 13-16 mm. ♀. L. 17-18 mm.; w. 15-16 mm.

(May-July) Ont., Que., N. B., Me., Vt., Mass., Ct., N. Y., Pa., Mich.

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Cornwall Bridge, June 13, 1931 (M. M. A.); Hamden, June 2, 1928 (R. B. F.); Kent Falls, June 12-13, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Norfolk, May 31, 1931 (C. P. A.); Storrs, 1932.

T. (*Yamatotipula*) **vitrea** v. d. W.
1881. *Tipula vitrea* van der Wulp; Tijdschr. v. Ent., 24:150.

Figs.—Van der Wulp, *Ibid.*, pl. 15, fig. 5 (wing). Dickinson, Cfls. Wisc., p. 229, fig. 134 (wing), p. 248, fig. 168 (hyp.); 1932.

The identity of this fly still remains in question. I am including it herewith chiefly on its supposed recognition by Dickinson, whose figure of its hypopygium is very suggestive of *kennicotti*. The fly seems to be closest to *tricolor*, and may prove to be identical.

(Oct.) Que., Wisc.

Subgenus **Tipula** Linnaeus

1758. *Tipula* Linnaeus; Syst. Nat., Ed. 10:585.

Rs of moderate length, about one-half longer than *m-cu* or less, the latter at or close to midlength of cell *1st* M_2, closer to base in the *ultima* group. Tibial spur formula 1-2-2; claws (♂) with basal tooth. Squama and sternopleurite with or without setae. Male hypopygium with sternite and tergite fused into a continuous ring;

median region of tergite produced caudad into a depressed lobe (*oleracea* group) or notched medially (*ultima* group).

Close to *Yamatotipula* and possibly not separable therefrom. The former is maintained as a unit chiefly for convenience in handling species.

Key to Species

1. Squama with setae; *Sc* relatively long, Sc_2 ending in R_1 beyond three-fourths the length of *Rs*; *Rs* nearly straight, not arcuated, beyond origin running nearly parallel to R_1; wings subhyaline, the costal border conspicuously darker; caudal margin of tergite of male hypopygium produced caudad into a median lobe (*oleracea* group) .... **paludosa** ?
   Squama naked; *Sc* short, Sc_2 ending in R_1 opposite or just beyond midlength of *Rs*; *Rs* arcuated or diverging gradually from R_1; wings without a dark costal border (except in *cunctans*); caudal margin of tergite of male hypopygium variously notched (*ultima* group) 2
2. Costal border of wing, including cells *C* and *Sc*, strongly infumed, conspicuously and abruptly darker than the pale brownish remainder of disk.. **cunctans**
   Costal border of wing not conspicuously darker than the yellow or brownish yellow remainder of wing.. 3
3. Wings patterned with brown, including dark areas at both ends of stigma, in cell *M* and at outer end of vein *2nd A*; male hypopygium with tergite (Fig. 29, C) conspicuously notched medially, the wide lateral lobes set with blackened pegs .... **ultima**
   Wing-pattern obsolete or nearly so, in *tennessa* the dark cloud at end of vein *2nd A* sometimes present but small; male hypopygium with tergite not deeply notched, the apices of lobes not provided with a series of blackened pegs 4
4. Wings with dark seam at end of vein *2nd A* sometimes evident; male hypopygium with apex of tergite gently notched (Fig. 29, B), the margins of lobes not blackened but each provided with a single black spine on ventral face, this directed ventrad .... **tennessa**
   Wings without dark areas; male hypopygium more conspicuously notched, the margins of the lobes narrowly blackened but smooth .... **maritima**

Tipula (*Tipula*) **cunctans** Say. (Fig. 29, A).

1834. *Tipula cunctans* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:23.

1863. *T. casta* Loew; Berlin. Ent. Zeitschr., 7:289; ♂.

1863. *T. infuscata* Loew; *Ibid.*, 7:289; ♀.

Figs.—Hyslop, U. S. Bur. Ent., Bull. 85, pt. 7, figs. 60, 61 (dets., ad. ♂, ♀); 1910. Alexander, Cfls. N. Y., 1, pl. 45, fig. 220 (wing); pl. 50, fig. 274, pl. 53, fig. 332 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 230, fig. 136 (wing); p. 248, fig. 170 (hyp.); 1932.

Antennae with flagellum uniformly darkened or with basal segments weakly bicolored. Head and thorax gray, praescutal stripes slightly darker. Abdomen chiefly obscure yellow, the tergites with a median brown stripe. Hypopygium with tergite (Fig. 29, A); outer dististyle elongate; inner dististyle with an irregularly blackened comb on face. ♂. L. 11.5-14 mm.; w. 12-16 mm.; antenna, 3.5-4 mm. ♀. L. 15-17 mm.; w. 15-18 mm.

(Sept., Oct.) Ont., Que., N. B., Me., Mass., N. Y., N. J., Pa., westw. to Man., Ia., Kan. and Colo., southw. to Tenn., Ala. and Miss.

Connecticut.—New Haven, Oct. 16, 1903 (H. L. V.).

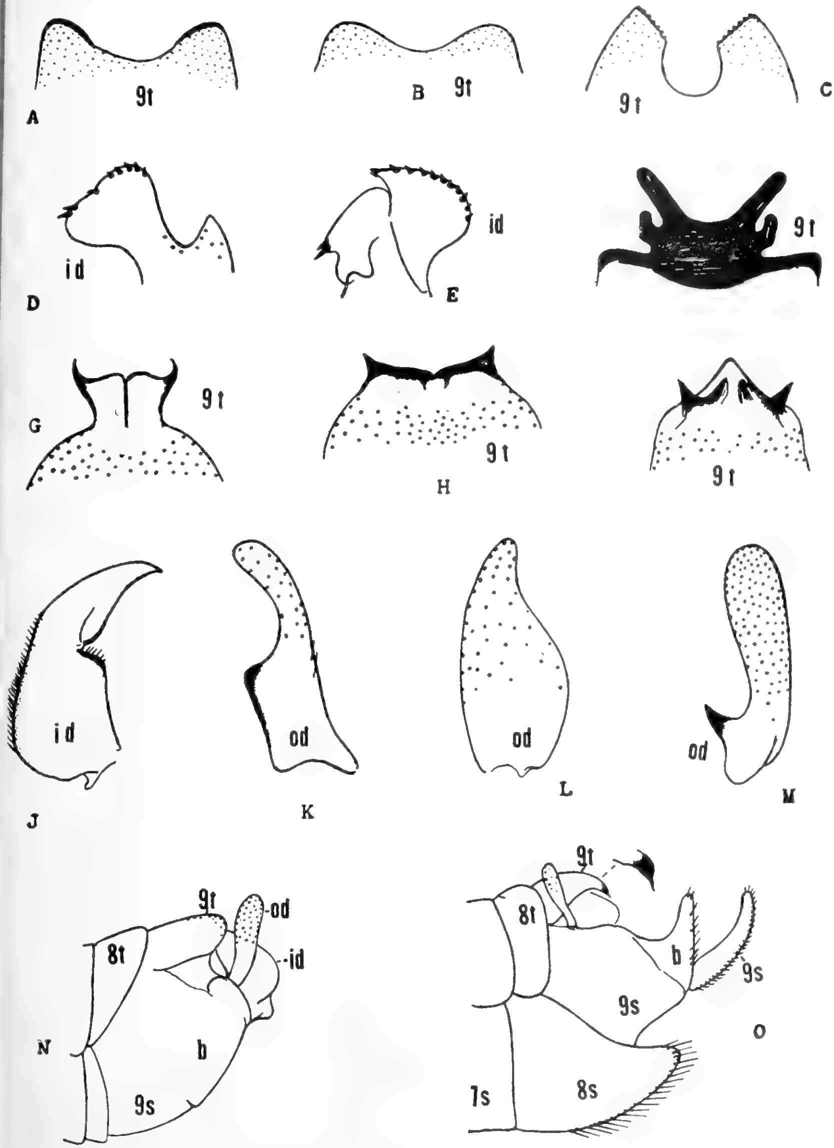


FIGURE 29. *Tipula (Tipula, Oreomyza)*; male hypopygia.

A. *T. (Tipula) cunctans* Say; *9t.*
B. *T. (T.) tennessa* Alex. *9t.*
C. *T. (T.) ultima* Alex.; *9t.*
D. *T. (Schummelia) friendi* Alex.; *id.*
E. *T. (S.) hermannia* Alex.; *id.*
F. *T. (Oreomyza) borealis* Walk.; *9t.*
G. *T. (O.) grata* Lw.; *9t.*
H. *T. (O.) helderbergensis* Alex.; *9t.*
I. *T. (O.) latipennis* Lw.; *9t.*
J. *T. (O.) fragilis* Lw.; *id.*
K. *T. (O.) fragilis* Lw.; *od.*
L. *T. (O.) ignobilis* Lw.; *od.*
M. *T. (O.) nebulipennis* Alex.; *od.*
N. *T. (O.) insignifica* Alex.; hypopygium, lateral aspect.
O. *T. (O.) productella* Alex.; the same.

Symbols: *b*, basistyle; *id*, inner dististyle; *od*, outer dististyle; *s*, sternite; *t*, tergite.

T. (*Tipula*) **maritima** Alex.
1930. *Tipula maritima* Alexander; Occas. Pap. Boston Soc. Nat. Hist., 5:276-277.

Antennae with flagellum bicolored, the enlargements black. Median notch of tergite narrower than in *cunctans*; outer dististyle small, expanded distally; flange on face of inner dististyle without a comb of teeth. ♂. L. 13-15 mm.; w. 14-17 mm.; antenna, about 4 mm.

(Oct.) Me., Mass. (Nantucket). (Austral).

T. (*Tipula*) **tennessa** Alex. (Fig. 29, B).
1920. *Tipula tennessa* Alexander; Can. Ent., 52:226-227.

Antennal flagellum bicolored. Dark seam at end of vein *2nd A* sometimes obsolete or virtually so, especially in Eastern specimens. Hypopygium with tergite (Fig. 29, B). ♂. L. 16-16.5 mm.; w. 18.5-19.5 mm.; antenna, about 4.5 mm. ♀. L. 19-21 mm.; w. 18-20 mm.

(Oct.) Mass., southw. to Tenn.

T. (*Tipula*) **ultima** Alex. (Fig. 29, C).
1805. *Tipula flavescens* Fabricius; Syst. Antl., p. 24 (preoccupied; *flavicans*, as written by later authors).
1915. *T. ultima* Alexander; Insec. Inscit. Menst., 3:128.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 14, fig. 108 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 47, fig. 232 (wing); pl. 50, fig. 273, pl. 53, fig. 333 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 230, fig. 137 (wing); p. 248, fig. 171 (hyp.); 1932.

Antennal flagellum bicolorous. Head and thorax pinkish gray, praescutal stripes ill-defined. Wings strongly suffused with yellow or brownish yellow, sparsely patterned with brown; stigma clear light yellow in central portion. Median tergal abdominal stripe reddish brown, not conspicuous; hypopygium large; tergite (Fig. 29, C): a median chitinized furcula on ventral side of tergite near base of notch. ♂. L. 15-17 mm.; w. 16-19 mm. ♀. L. 17-25 mm.; w. 16-23 mm.

(Late Aug.-Oct.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Sask., N. D. and Wyo., southw. to Tenn., Miss. and n. Fla.

Connecticut.—Branford, Oct. 1, 1929 (R. B. F.); E. Hartland, Sept. 1, 5, 11, 1928 (C. P. A.); New Haven, Oct. 16, 1903 (H. L. V.), Sept. 12, 1904 (B. H. W.); Norfolk, Sept. 11, 1928 (C. P. A.); Salisbury, Sept. 12, 1928 (C. P. A.); Stamford, Sept. 26, 1929, Sept. 18-Oct. 1, 1931 (B. T. R. L.); Storrs, 1929 (J. A. M.); Westville, Sept. 18, 1904 (W. E. B.); Windsor, Sept. 11, 1929 (J.A.M.).

T. (*Tipula*) near **paludosa** Mg.
1830. *Tipula paludosa* Meigen; Syst. Beschr., 6:289.
1930. *T. paludosa* Lackschewitz; Konowia, 9:267-269, pl. 1, fig. 2 (hyp.)

A species very close to *paludosa* has been taken several times at and near St. Johns, Newfoundland. More material is needed before

the species can be definitely determined but it is unquestionably close to *paludosa* and *subcunctans* Alex. (*czizeki* de Jong). The latter occurs throughout Europe and northern Asia into northern Japan and may well be found to be even more widespread in the Holarctic Region. Since the species of the group are of considerable economic importance, the determination of the true status of the Newfoundland insect is much to be desired. What is undoubtedly this same species has been recorded from Cape Race, Newfoundland, by A. H. Swinton, of Totnes, England (Ent. News, 20:436; 1909), as *Tipula oleracea* Linnaeus.

Subgenus **Schummelia** Edwards

1931. *Schummelia* Edwards; Ann. Mag. Nat. Hist. (10) 8:80-81.

Rs relatively short, subequal to the long *m-cu*; cell M_4 deep and markedly wider at base than at margin; *m-cu* very oblique, usually placed near base of the small or medium-sized cell *1st* M_2; M_4 in alignment with M_{3+4}; Cu_1 without a constriction or shirring at point of insertion of *m-cu*. Squama with setae; veins beyond cord with macrotrichia. Tibial spur formula 1-2-2. Male hypopygium with tergite and sternite separate, or (*hermannia*) fused on cephalic portion; in local species, median region of tergite produced into a compressed median blade, this more depressed in *T. idei*.

The antennae of males of the local species are elongate.

Key to Species

1. Wings immaculate, light yellow (♂) to strongly tinged with brown (♀); *m* obliterated or very short, the outer end of cell *1st* M_2 strongly pointed **annulicornis**
   Wings grayish subhyaline, clouded with pale brown, including major areas before cord; *m* of normal length, the outer end of cell *1st* M_2 truncated... 2
2. Antennal flagellum uniformly dark brown or black; outer dististyle of hypopygium long and narrow .... **idei**
   Antennal flagellum weakly to clearly bicolorous, the segments yellow to brownish yellow, the basal enlargements dark brown or black; outer dististyle of hypopygium broad and depressed 3
3. Male hypopygium with median tergal blade small, subtended laterally by an acute spine; posterior appendage of inner dististyle with a blackened tooth-like lobe separated from the apex by a U-shaped notch (Fig. 29, D) **friendi**
   Male hypopygium with median tergal blade large and expanded, subtended laterally by a short spine; posterior appendage of inner dististyle bifid, the two parts separated only by a linear slit (Fig. 29, E).......... **hermannia**

Tipula (*Schummelia*) **annulicornis** Say.

1829. *Tipula annulicornis* Say; Journ. Acad. Nat. Sci. Philadelphia, 6:151 (♂).
1909. *T. jejuna* Johnson; Proc. Boston Soc. Nat. Hist., 34:132 (♀).

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 243 (wing), pl. 50, fig. 288, pl. 53, fig. 335 (hyp.); 1919.

Sexes strongly dimorphic in color. Antennae (♂) elongate, bicolorous, yellow, the basal enlargements of flagellar segments black; if bent backward extending to opposite or beyond two-thirds the

length of the abdomen. Thorax of male yellow, of female more reddish brown. Caudal margin of tergite of male hypopygium a compressed median blade. ♂. L. 8-9 mm.; w. 8-10 mm.; antenna, 6-6.5 mm. ♀. L. 10-11.5 mm.; w. 8-8.5 mm.

(July, Aug.) Mass., Ct., N. Y., N. J., westw. to Ind. and Mich., southw. to Md. and Tenn. (Transition).

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); East River, July 23, 1911 (Ely).

T. (*Schummelia*) **friendi** Alex. (Fig. 29, D).

1941. *Tipula* (*Schummelia*) *friendi* Alexander; Amer. Mid. Nat., 26:293—Figs. 6, 7 (hypopygium).

♂. L. about 11 mm.; w. 11 mm.

Characters almost as in *hermannia*, differing especially in the details of the male hypopygium.

Antennae shorter, the flagellar segments weakly bicolorous, brown, the basal enlargements blackened. Wings without dark cloud at midlength of vein *Cu*. Hypopygium with median blade of tergite smaller, subtended by long, slender spines, narrower and more distinct than in *hermannia*. Posterior appendage of inner dististyle (Fig. 29, D) with a blackened tooth-like projection separated from main body of appendage by a U-shaped notch. In *hermannia* (Fig. 29, E) the two lobules of the posterior appendage lie close together and are of very different conformation. Fleshy lobes of basistyle more oval, with more abundant setae that extend to bases of lobes; in *hermannia*, the lobes more flattened, with setae more restricted to outer half.

This interesting fly, named in honor of Dr. Roger B. Friend, is now known to range from Massachusetts southward to the higher mountains of North Carolina and Tennessee, being adult in June and July.

T. (*Schummelia*) **hermannia** Alex. (Fig. 29, E).

1863. *Tipula fasciata* Loew; Berlin. Ent. Zeitschr., 7:279 (preoccupied).

1915. *T. hermannia* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:480.

Figs.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 211 (wing), pl. 50, fig. 287, pl. 54, fig. 343 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 235, fig. 150 (wing); p. 249, fig. 184 (hyp.); 1932.

Praescutum light gray, with four darker gray stripes. Wings with an extensive dark cloud in ends of cells R and M and part of M_4 adjoining *m-cu*; petiole of cell M_1 seamed with brown. Male hypopygium enlarged; posterior lobe of inner dististyle (Fig. 29, E). ♂. L. 11-12 mm.; w. 10-11 mm.; antenna, 5-7 mm. ♀. L. 13-14 mm.; w. 12-13 mm.

(Late May-early Aug.) Ont., Que., Nfd., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc. and Kan., southw. to S. C., Ga., n. Fla. and Tenn. (Canadian, Transition).

Connecticut.—Granby, June 8, 1929 (C. P. A.); Kent Falls, July 23-24, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norwalk, May 21, 1930

(R. B. F.); Putnam, June 15, 1933 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Tunxis State Park, June 12, 1931 (C. P. A.); Winnipauk, June 16, 1909 (C. W. J.).

T. (*Schummelia*) **idei** Alex.
1928. *Tipula idei* Alexander; Can. Ent., 60: 55.

Antennae more elongate than in *hermannia*. Male hypopygium with median lobe of tergite short, depressed or nearly so, glabrous. A small bifid pale lobe in notch of ninth sternite, not terminating in an elongate seta, as in *friendi* and *hermannia*. ♂. L. 10-11.5 mm.; w. 9.5-11 mm.; antenna, 7-8.5 mm.

(June, July) Ont., Que., southw. to higher mountains of N. H. (Presidential Range), and N. Y. (Adirondacks), westw. to B. C. (Hudsonian, high Canadian).

Subgenus **Oreomyza** Pokorny

1887. *Oreomyza* Pokorny; Wien. Ent. Zeitg., 6: 50.

Rs of moderate length; *m-cu* some distance beyond the fork of *M* except in the *fragilis* group. Squama naked; outer branches of *M* with macrotrichia. Tibial spur formula 1-2-2; claws (♂) simple, or, in all local species, with basal tooth. Male hypopygium with tergite and sternite distinct. Ovipositor with slender, smooth cerci.

Includes almost all members of the so-called "Marmoratae", having the wings variously clouded and spotted with brown or gray. Edwards has suggested that the name be re-instated and used to include those species with marmorate wings having the squama naked and claws of male simple. All of our local forms have toothed claws, at least on fore tarsi, and I am herewith modifying the above definition to include such species. In a few species, R_{1+2} is atrophied.

Key to Groups

1. Male hypopygium elongated, cylindrical, upturned at an angle to remainder of abdomen; ninth tergite long and narrow, its length exceeding twice the width, the apex variously armed with blackened decurved points that are not clearly visible from above; eighth sternite more or less deeply trilobed, the margins fringed with yellow setae. Lateral praescutal stripes margined anteriorly and laterally with dark brown, forming ∩-shaped areas; median stripe bordered laterally with brown..*borealis* group
   Male hypopygium not elongated, from small to very large, not upturned, as above described; ninth tergite usually broader than long, the apex without blackened decurved points; eighth sternite with the actual margin entire or at most emarginate; in *trivittata* group sometimes with accessory lobes or brushes of setae. Praescutal stripes usually entire, when bordered with brown, the pattern not as described and the interspaces usually dotted with brown punctures and the median stripe further split by a capillary darker line 2
2. Basal section of M_{3+4} short to very short, less than the basal section of M_{1+2}, *m-cu* thus joining *M* before level of *r-m*; *m cu* less than twice *Rs*; wing-pattern very pale, gray, variegated by white areas; cell *Sc* uniformly darkened, contrasting with remainder of wing; stigma brown; no arcular darkening. Male hypopygium with eighth sternite simple or apex merely emarginate, without accessory lobes...................*fragilis* group

Basal section of M_{3+4} usually longer, subequal to or longer than basal section of M_{1+2}, *m-cu* joining *M* opposite or beyond level of *r-m;* where above is questionable, *Rs* is more than twice *m-cu*; wing-pattern usually heavy, variegated brown, gray and whitish, often with a dark area at arculus; cell *Sc* not darkened unless remainder of ground-color is likewise infumed. Male hypopygium with eighth sternite simple or variously provided with lobes or pencils of setae .... *trivittata* group

The *borealis* or *unca* group.

Antennae tending to be elongate. Male hypopygium with the inner dististyle very complex, its lowermost appendage forming a pale to sclerotized pendulous lobe that extends cephalad along the ventral surface of hypopygium. The species are most numerous in midsummer, being commonly found in mesophytic woodlands.

Key to Species

1. Antennae with at least the basal flagellar segments bicolorous, yellow, the enlargements dark 2
   Antennae with flagellar segments uniform in color 3
2. A narrow, interrupted dark stripe on dorsal thoracic pleura, extending from cervical sclerites to beneath the wing-root; male hypopygium with lower pendulous lobe of inner dististyle pale .... **borealis**
   No darkened pleural stripe; male hypopygium with the pendulous lobe of inner dististyle strongly sclerotized, brownish black .... **inclusa**
3. Antennae (♂) elongate, if bent backward extending about to midlength of second abdominal segment 4
   Antennae shorter in both sexes, in ♂, if bent backward, extending about to base of halteres or shortly beyond 5
4. Male hypopygium with eighth sternite deeply trilobed, fringed with long golden-yellow setae; gonapophyses relatively short and inconspicuous, not twisted, the tips decurved; ninth tergite not terminating in a median point (Fig. 29, H) .... **helderbergensis**
   Male hypopygium with eighth sternite scarcely lobed, the setae shorter and inconspicuous; gonapophyses elongate, twisted on their own axes, jutting from genital chamber; ninth tergite projecting as a median point (Fig. 29, I) .... **latipennis**
5. Wing-pattern subobsolete; size small (wing, ♂, under 12 mm.); male hypopygium with lower process of inner dististyle very long and membranous **gaspensis**
   Wing-pattern distinct; size larger (wing, ♂, over 13 mm.); male hypopygium with the lower process of inner dististyle more or less sclerotized and blackened apically 6
6. Antennal flagellum pale, yellowish brown; lower pendulous lobe of inner dististyle short, slender, claw-like .... **grata**
   Antennal flagellum dark brown; lower pendulous lobe of inner dististyle broad, pale, the apex obtuse .... **afflicta**

Tipula (*Oreomyza*) **afflicta** Dtz.

1914. *Tipula suspecta* Dietz; Trans. Amer. Ent. Soc., 40:351-352; (nec *suspecta* Loew, 1863).

1915. *T. afflicta* Dietz; Ent. News, 26:125.

Figs.—Dietz, Trans. Amer. Ent. Soc., 40, pl. 13, figs. 5, 6 (hyp.), pl. 14, fig. 2 (wing); 1914.

Male hypopygium with lower process of inner dististyle broad, the apex obtuse, somewhat sclerotized apically. ♂. L. 13 mm.; w. 13.5 mm.

(July) N. Y. Still known from the unique type.

T. (*Oreomyza*) **borealis** Wk. (Fig. 29, F).
1848. *Tipula borealis* Walker; List Dipt. Brit. Mus., 1:66.
1863. *T. hebes* Loew; Berlin. Ent. Zeitschr., 7:285.

Figs.—Dietz, Trans. Amer. Ent. Soc., 40, pl. 13, fig. 1 (hyp.); 1914. Alexander, Cfls. N. Y., 1, pl. 48, fig. 249 (wing); 1919. Dickinson, Cfls. Wisc., p. 233, fig. 142 (wing), p. 249, fig. 177 (hyp.); 1932.

Antennae (♂) elongate, if bent backward extending to beyond base of abdomen. Male hypopygium with apex of tergite truncate, with four blackened decurved points, the lateral pair shorter (Fig. 29, F). ♂. L. 13-15 mm.; w. 14-16 mm.; antenna, 6-6.5 mm. ♀. L. 16-17 mm.; w. 15-16 mm.

(June-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc. and Kan., southw. to S. C. and Tenn.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Branford, Aug. 1905 (H. W. W.); E. Haddam, Aug. 25, 1929 (R. B. F.); East River, Aug. 15, 1911 (Ely); Hamden, July 31, 1928 (R. B. F.); Middlebury, Aug. 10, 1928 (R. B. F.); Stony Creek, Aug. 12, 1904 (P. L. B.); Storrs; Tyler Lake, July 23, 1931 (C. P. A.); Connecticut, without more accurate data, Norton, Loew's type of *hebes*.

T. (*Oreomyza*) **gaspensis** Alex.
1929. *Tipula gaspensis* Alexander; Can. Ent., 61:233-234.

Ventral sternopleurite darkened. Male hypopygium with caudal margin of sternite not conspicuously emarginate. Abdomen with a conspicuous median brown stripe on both tergites and sternites. ♂. L. 9-10 mm.; w. 10.5-11.5 mm.; antenna, 4-4.5 mm. ♀. L. 13-13.5 mm.; w. 11.5 mm.

(June-July) Que.

T. (*Oreomyza*) **grata** Lw. (Fig. 29, G).
1863. *Tipula grata* Loew; Berlin. Ent. Zeitschr., 7:281.

Fig.—Alexander, Cfls. N. Y., 1, pl. 51, fig. 292 (hyp.); 1919.

Two or three dusky areas on dorsal thoracic pleura. Male hypopygium with eighth sternite conspicuously trilobed, the setae short but dense. Ninth tergite with apex (Fig. 29, G) a flattened plate, the outer lateral angles appearing as curved acute horns. ♂. L. 12 mm.; w. 13.5-14 mm.; antenna, about 4 mm. ♀. L. 14-15 mm.; w. 14 mm.

(June-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ind., Mich., Minn. and Alta.

Connecticut.—Kent Falls, June 12-13, 1931 (M. M. A.).

T. (*Oreomyza*) **helderbergensis** Alex. (Fig. 29, H).
1918. *Tipula helderbergensis* Alexander; Can. Ent., 50:64-65.

Mesonotal praescutum with an elongate dark triangle at cephalic portion of each intermediate stripe. Abdomen chiefly dark brown. Male hypopygium with caudal border of tergite blackened, extended

into lateral points (Fig. 29, H). ♂. L. 12-13 mm.; w. 13-14 mm.; antenna, about 6 mm. ♀. L. 14.5 mm.; w. 14.5 mm.

(July, Aug.) Ont., N. B., N. Y., westw. to Mich.

T. (*Oreomyza*) **inclusa** Dtz.
1921. *Tipula inclusa* Dietz; Trans. Amer. Ent. Soc., 47: 267-268.

Lateral processes of inner dististyle of male hypopygium with all branches strongly sclerotized. ♂. L. 13 mm.; w. 14 mm.

(July, Aug.) Pa.

T. (*Oreomyza*) **latipennis** Lw. (Fig. 29, I).
1848. *? Tipula resurgens* Walker; List Dipt. Brit. Mus., 1: 67.
1864. *T. latipennis* Loew; Berlin. Ent. Zeitschr., 8: 60.
1914. *T. ottawaensis* Dietz; Trans. Amer. Ent. Soc., 40: 349-351.

Figs.—Dietz, *Ibid.*, pl. 13, figs. 2-4 (hyp.), pl. 14, fig. 1 (wing). Alexander, Cfls. N. Y., 1, pl. 51, fig. 293 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 233, fig. 143 (wing), p. 249, fig. 178 (hyp.); 1932.

Dark borders of intermediate praescutal stripe broad, restricting the stripe itself to a narrow vitta. Male hypopygium with upper process of inner dististyle expanded, more or less adz-shaped; ninth tergite, apex (Fig. 29, I). ♂. L. 13-14 mm.; w. 14-15 mm.; antenna, about 7 mm. ♀. L. 17-18 mm.; w. 16-17 mm.

(Late June-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., westw. to Wisc., Man. and Alta.

The *fragilis* or *marmorata* group.

Antennae of moderate length; scape and pedicel yellow; flagellum uniformly brownish black or black, not or scarcely bicolored. General coloration gray, the praescutum with four entire brown stripes. Wings with cephalic margin of cell *1st* M_2 (second section of M_{1+2}) often arched, narrowing cell R_5. Male hypopygium small; eighth sternite often modified.

A small group of chiefly autumnal crane-flies. Of the local species, three (*nebulipennis*, *phoroctenia*, *productella*) have the eighth sternite modified; two (*fragilis*, *nebulipennis*) have the outer dististyle blackened and dilated at base.

Key to Species

1. Radial cells beyond cord not brightened; dark pattern of wings obsolete or nearly so .... **insignifica**
   Bases of cell R_2 and usually also of R_3 brightened by whitish; dark pattern of wing evident 2
2. Size very small (wing, ♂, less than 9.5 mm.); cell *Sc* and outer half of cell *C* darkened .... **perparvula**
   Size larger (wing, ♂, 10.5 mm. or more); cell *Sc* darkened (except in *ignobilis*), cell *C* clear 3
3. Male hypopygium with basistyle produced caudad into a slender lobe (Fig. 29, O) .... **productella**
   Basistyle not produced 4

4. Male hypopygium with eighth sternite of normal size, simple, the caudal margin not emarginate, provided with an apical group of setae............ 5
   Male hypopygium with the eighth sternite enlarged, the apex more or less emarginate, its apical margin or lateral lobes provided with spines (*phoroctenia*) or strongly developed setae (*nebulipennis*) 7
5. Ninth tergite of male hypopygium margined with blackened spines; lateral ends not produced into decurved points .... **packardi**
   Ninth tergite with margin smooth, or (*fragilis*) with a few scattered spines near outer end of the decurved lateral lobes 6
6. Praescutal stripes ending at level of pseudosutural foveae; intermediate pair usually blunt at cephalic ends; terminal abdominal segments not conspicuously darkened; male hypopygium with outer dististyle expanded and blackened on basal portion (Fig. 29, K) .... **fragilis**
   Intermediate praescutal stripes extending about to anterior end of sclerite, the cephalic ends of the stripes bifid; terminal abdominal segments chiefly blackish; male hypopygium with outer dististyle a simple pale flattened blade (Fig. 29, L) .... **ignobilis**
7. Male hypopygium with the eighth sternite strongly projecting, shovel-like; posterior margin shallowly notched and armed with a comb-like row of blackened spines; outer dististyle entirely pale .... **phoroctenia**
   Male hypopygium with the eighth sternite slightly projecting, the posterior margin with a broad, shallow, U-shaped notch, the emargination with short whitish hairs, the lobes with longer setae; outer dististyle with a blackened acute tooth at base (Fig. 29, M) .... **nebulipennis**

Tipula (*Oreomyza*) **fragilis** Lw. (Figs. 29, J, K).
1863. *Tipula fragilis* Loew; Berlin. Ent. Zeitschr., 7:279.
1863. *T. suspecta* Loew; *Ibid.*, 7:280.

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 250 (wing), pl. 51, fig. 297 (hyp.); 1919.

Tips of femora narrowly blackened. Male hypopygium with eighth sternite unmodified. Ninth tergite notched, lateral angles acute, decurved and set with a few spinous points. Outer dististyle (Fig. 29, K). Inner dististyle (Fig. 29, J) with apical point slender. ♂. L. 10-11 mm.; w. 12-13 mm. ♀. L. 13-14 mm.; w. 13-14 mm.

(Sept., Oct.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Alta., southw. to D. C.

Connecticut.—Norfolk, Sept. 11, 1928 (C. P. A.).

T. (*Oreomyza*) **ignobilis** Lw. (Fig. 29, L).
1863. *Tipula ignobilis* Loew; Berlin. Ent. Zeitschr., 7:280.

Fig.—Alexander, Cfls. N. Y., 1, pl. 51, fig. 298 (hyp.); 1919.

Much as in *fragilis*, differing especially in hypopygial characters. Ninth tergite emarginate, the lobes short and obtuse, without spines. Outer dististyle (Fig. 29, L) broadly expanded basally but entirely pale. ♂. L. 9-10 mm.; w. 10.5-12 mm. ♀. L. 12 mm.; w. 13 mm.

(June-early Aug.) N. B., Me., N. H., N. Y., westw. to Ill., southw. to S. C. and Tenn.

Connecticut.—Colebrook, Aug. 10 (W. M. W.); Portland, June 24, 1932 (N. T.).

T. (*Oreomyza*) **insignifica** Alex. (Fig. 29, N).
1924. *Tipula insignifica* Alexander; Occas. Pap. Boston Soc. Nat. Hist., 5:117-118.

The usual dark and whitish wing-pattern characteristic of the group almost obsolete. Male hypopygium (Fig. 29, N) simple; tergite with a V-shaped median notch, lateral lobes obliquely truncated, unarmed. Outer dististyle simple, subcylindrical to slightly flattened, of nearly equal width throughout. Eighth sternite simple and unarmed. ♂. L. about 9 mm.; w. 11.8 mm.

(Aug., Sept.) Me. (Katahdin), N. H., alpine summits of Mt. Washington and Mt. Madison, White Mountains, 5000-5500 ft. (Hudsonian).

T. (*Oreomyza*) **nebulipennis** Alex. (Fig. 29, M).
1919. *Tipula nebulipennis* Alexander; Can. Ent., 51: 170-171.

Intermediate praescutal stripes nearly confluent in front. Outer abdominal segments darkened; hypopygium relatively large. Tergite with blackened spinous setae. ♂. L. 11-13 mm.; w. 11-13 mm. ♀. L. 13-14 mm.; w. 13-13.5 mm.

(Late June-early Aug.) Lab.; E. Que.; N. H., higher altitudes of Mt. Washington, 4700-5000 ft. (Hudsonian).

T. (*Oreomyza*) **packardi** Alex.
1928. *Tipula packardi* Alexander; Can. Ent., 60: 99-100.

Male hypopygium with outer dististyle relatively slender, pale throughout; inner dististyle compressed, arcuate, the lower apical angle produced into an acute black spine. ♂. L. 13-13.5 mm.; w. 12.5-13.2 mm.

(Aug.) Lab. (Hudsonian).

T. (*Oreomyza*) **perparvula** Alex.
1926. *Tipula perparvula* Alexander; Insec. Inscit. Menst., 14: 120-122.

Median praescutal stripe sometimes entire, sometimes weakly divided by a pale vitta. Abdomen blackened subterminally. Male hypopygium with outer dististyle narrow and entirely pale. ♂. L. 7.8-8 mm.; w. 9.3 mm.

(June) Man. (Canadian).

T. (*Oreomyza*) **phoroctenia** Alex.
1919. *Tipula phoroctenia* Alexander; Can. Ent., 51: 170.

Male hypopygium with ninth sternite emarginate, from base of notch with a stout reddish rod that is weakly and unequally bifid. Tergite with a V-shaped notch, the margin narrowly blackened, the lateral angles extended into slender blackened points. ♂. L. 13 mm.; w. 14 mm.

(Oct.) Me., westw. to B. C. (Canadian).

T. (*Oreomyza*) **productella** Alex. (Fig. 29, O).
1928. *Tipula productella* Alexander; Can. Ent., 60: 100-101.

Readily told from all other regional species by the caudally produced basistyle (Fig. 29, O). Lateral tergal lobes appearing as decurved black points. Outer dististyle narrow, entirely pale, with

relatively few setae. An elongate yellow lobe arises from ninth sternite. Eighth sternite large, deeply emarginate, the lobes clothed with long yellow setae. ♂. L. about 10 mm.; w. 12.3 mm.

(Sept.) Lab. (Hudsonian).

The *trivittata* group.

Key to Species

1. Tip of R_{1+2} atrophied 2
   R_{1+2} entire 4
2. Wings with basal fourth nearly clear, without well-defined clouds; *Rs* and R_3 subequal in length; male hypopygium with basistyle produced into an acute spine .... **penobscot**
   Wings with clouds in cells *R* and *M* basad of origin of *Rs* and in bases of Anal cells; *Rs* relatively long, exceeding R_3; male hypopygium with the basistyle simple (not known to me for *subfasciata*) 3
3. Flagellum uniformly darkened; cell *1st* M_2 long, subequal in length to cell M_1; praescutum with three brown stripes.......... **subfasciata**
   Flagellum weakly bicolorous, dark brown, the basal enlargements of the segments brownish black; cell *1st* M_2 shorter than cell M_1; praescutum with four brown stripes, the intermediate pair divided by a pale vitta... **decora**
4. Nasus lacking 5
   Nasus present 6
5. Abdominal tergites with a dark median stripe; male hypopygium with a small median depressed bispinous plate on caudal margin of eighth sternite (Fig. 30, K) .... **serta**
   Abdominal tergites with the median stripe lacking or subobsolete; male hypopygium with a short finger-like lobe on either side of a median subquadrate fleshy plate (Fig. 30, L) .... **neptun**
6. Bases of cells *R* and *M* beyond arculus clear; white band beyond cord short, extending only into base of cell M_3; ovipositor with cerci relatively short and pale, feebly sclerotized 7
   Bases of cells *R* and *M* with a dark spot beyond arculus; white band beyond cord completely traversing wing or nearly so, attaining the posterior margin in cell M_3 (exceptions in *stylifera* and *ternaria*); ovipositor with cerci long and slender, heavily sclerotized and blackened 8
7. Abdominal tergites pale brown, without dark stripes; male hypopygium with median plate of eighth sternite with two lateral spines on either side (Fig. 30, F); ovipositor with cerci broad .... **senega**
   Abdominal tergites obscure orange, trivittate with dark brown, the median vitta broad; male hypopygium with median plate of eighth sternite with a single lateral spine on either side (Fig. 30, D); ovipositor with cerci narrowed and subacute on apical half .... **illinoiensis**
8. Antennae entirely darkened; pale area beyond cord of wing confined to radial field; abdominal tergites beyond the second conspicuously ringed caudally with yellow .... **ternaria**
   Antennae with at least the basal two or three segments pale; crossband beyond cord traversing the wing or virtually so; outer abdominal tergites not ringed caudally with yellow 9
9. Antennal flagellum uniformly brownish black or black 10
   Antennal flagellum distinctly bicolorous 12
10. All femora with a subterminal yellow ring, preceded and followed by a broad black annulus; abdominal tergites with a conspicuous median black stripe; praescutal interspaces without brown dots; male hypopygium with eighth sternite provided with two long hair tufts.......... **margarita**
    All femora yellowish or brownish yellow; abdominal tergites not conspicuously trivittate with black; praescutal interspaces with abundant brown setigerous punctures; male hypopygium with eighth sternite unarmed.... 11

11. Male hypopygium with the notch of the ninth tergite V-shaped, the lateral margins with small denticles (Fig. 30, B); posterior margin of inner dististyle at base with an acute spine .... **entomophthorae**
    Male hypopygium with the notch of the ninth tergite transversely U-shaped, shallow, without lateral denticles (Fig. 30, M); posterior margin of inner dististyle not spinous .... **trivittata**
12. Male hypopygium with basistyle produced dorsad into a long slender process **stylifera**
    Male hypopygium with basistyle simple, not produced 13
13. Praescutal interspaces with brown setigerous punctures .... **entomophthorae**
    Praescutal interspaces not dotted with brown 14
14. A dark spot in cell *C* opposite midlength of *Rs*; white band before cord extending unbroken from veins *R* to *Cu*; male hypopygium with tergite deeply notched medially, the lateral angles produced caudad into long acute points (Fig. 30, C) .... **huron**
    No distinct dark spot in cell *C* near outer end; white band before cord more or less interrupted by a dark clouding in posterior portion of cell *R* adjoining vein *M*, restricting the band to isolated areas in cell *M* and at midlength of *Rs*; male hypopygium with caudal border of tergite truncate, with a small quadrate median notch, at base of which is a small denticle (Fig. 30, A) 15
15. Pale crossband beyond cord incomplete, extending about to midlength of cell M_3; antennal flagellum clearly bicolorous, light yellow, the basal enlargements black .... **huntsmaniana**
    Pale crossband beyond cord complete, attaining the wing-margin in cell M_3; antennal flagellum indistinctly bicolorous, brownish yellow to brown, the basal enlargements still darker, brownish black to black .... **angulata**

Tipula (*Oreomyza*) **angulata** Lw. (Fig. 30, A).
1864. *Tipula angulata* Loew; Berlin. Ent. Zeitschr., 8:61.

Figs.—Alexander, Cfls. N. Y., 1, pl. 51, fig. 291; pl. 54, fig. 340 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 231, fig. 138 (wing), p. 248, fig. 172 (hyp.); 1932.

Antennae relatively long, if bent backward extending to beyond base of abdomen; in cases, the antennal flagellum is so dark that the bicolorous nature is almost lost. Centers of praescutal stripes restrictedly pale. Tergite of hypopygium (Fig. 30, A). ♂. L. 12-15 mm.; w. 12.5-17.5 mm.; antenna, 5.5-6 mm. ♀. L. 14-15 mm.; w. 15-16 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ill. and Wisc. (Canadian).

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Riverton, June 12, 1931 (C. P. A.).

Compare notes on *decora* and *huntsmaniana*, below.

T. (*Oreomyza*) **decora** Doane.
1901. *Tipula decora* Doane; Journ. N. Y. Ent. Soc., 9:125.

In all respects other than the atrophied R_{1+2} almost exactly like *angulata* and the validity is very doubtful. ♂. L. 12 mm.; w. 14 mm.

(June) Que., N. Y. (Canadian).

T. (*Oreomyza*) **entomophthorae** Alex. (Fig. 30, B).
1918. *Tipula entomophthorae* Alexander; Can. Ent., 50:385-386.
1921. *T. similissima* Dietz; Trans. Amer. Ent. Soc., 47:263-264.

Fig.—Dickinson, Cfls. Wisc., p. 249, fig. 176 (hyp.); 1932.

Antennae (♂) short, if bent backward scarcely reaching the wing-root; in cases, antennal flagellum weakly bicolorous. Femora brown or yellowish brown, the tips not darkened. Abdominal tergal stripes very narrow and pale. Tergite of hypopygium (Fig. 30, B). ♂. L. 15-16 mm.; w. 15-16 mm.; antenna, 4.3-4.5 mm. ♀. L. 21-22 mm.; w. 17-18 mm.

(June-Aug.) Ont., Que., Lab., Me., N. H., Vt., N. Y., Pa., westw. to Ind., Mich., Wisc. and Alta., southw. to N. C. (Canadian).

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.); Riverton, June 12, 1931 (C. P. A.).

T. (*Oreomyza*) **huntsmaniana** *Dtz.*
1920. *Tipula huntsmaniana* Dietz; Can. Ent., 52: 7-8.

Except for the more brightly colored antennal flagellum and slightly less complete pale band beyond the cord, the present fly is exceedingly close to *angulata*. Validity very doubtful. ♂. L. 13 mm.; w. 13.5 mm.

(June, early July) Ont., N. S. (Canadian).

T. (*Oreomyza*) **huron** Alex. (Fig. 30, C).
1918. *Tipula huron* Alexander; Can. Ent., 50: 66-67.

Fig.—Dickinson, Cfls. Wisc., p. 249, fig. 180 (hyp.); 1932.

Tergite of hypopygium (Fig. 30, C). ♂. L. 14 mm.; w. 15.5 mm.

(June) Wisc. (Canadian).

This may be the species reported from Wisconsin by Dickinson as *T. armata* Doane, a very different fly.

T. (*Oreomyza*) **illinoiensis** Alex. (Fig. 30, D, I).
1863. *Tipula versicolor* Loew; Berlin. Ent. Zeitschr., 7: 285 (preoccupied).
1915. *T. illinoiensis* Alexander; Insec. Inscit. Menst., 3: 128.

Closest to *senega*. Male hypopygium with tergite (Fig. 30, I) having lateral arms very short and broad; median lobe triangular, without oblique carinae. Eighth sternite (Fig. 30, D). ♂. L. 14-15 mm.; w. 15.5-17 mm.; antenna, about 5 mm. ♀. L. 13-19 mm.; w. 15-19 mm.

(Late May, June) Ont., N. H., westw. to Ill. and Man.

T. (*Oreomyza*) **margarita** Alex. (Fig. 30, E).
1918. *Tipula margarita* Alexander; Can. Ent., 50: 243-244.

Antennae very short, if bent backward extending to about two-thirds the distance to wing-root. Praescutal median stripe divided by a pale vitta that is further divided by a dark capillary vitta. Sub-lateral dark lines on abdominal tergites narrow, the lateral margins broadly gray. In female, all three tergal stripes broad and entire,

black. Male hypopygium with the tergal lobes reddish, flattened, broadly obtuse, separated by a narrow U-shaped notch (Fig. 30, E). Hair-pencils of eighth sternite long, curved, decussate on the mid-line. ♂. L. 13-14 mm.; w. 14-14.5 mm.; antenna, about 3 mm. ♀. L. 23-24 mm.; w. 18 mm.

(June) N. Y., Ohio. (Transition).

T. (*Oreomyza*) **penobscot** Alex. (Fig. 30, H).
1915. *Tipula penobscot* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 472-474.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 4 (wing), pl. 18, fig. 32, pl. 19, fig. 45 (hyp.). Alexander, Cfls. N. Y., 1, pl. 48, fig. 247 (wing), pl. 50, fig. 275, pl. 53, fig. 334 (hyp.); 1919.

Coloration gray; praescutal stripes relatively indistinct. Wings with cell *1st* M_2 short and wide, less than two-thirds the length of cell M_1; dark spot at origin of *Rs* small. Tergite of hypopygium (Fig. 30, H). ♂. L. 9-11 mm.; w. 10.5-13 mm.; antenna, 3.5-4 mm. ♀. L. 13-15 mm.; w. 13-15 mm.

(June, July) Ont., Que., N. B., Me., N. H., Mass., N. Y., Pa., westw. to Mich. and Alta. (Canadian).

Connecticut.—Norfolk, June 9, 1929 (C. P. A.).

T. (*Oreomyza*) **senega** Alex. (Figs. 30, F, G).
1863. *Tipula pallida* Loew; Berlin. Ent. Zeitschr., 7: 284 (preoccupied).
1915. *T. senega* Alexander; Insec. Inscit. Menst., 3: 128.

Figs.—Alexander, Cfls. N. Y., 1, pl. 45, fig. 213 (wing), pl. 50, fig. 278 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 234, fig. 149 (wing), p. 250, fig. 188 (hyp.); 1932.

General coloration pale yellow; praescutum with four entire brown stripes. Flagellar segments (♂) strongly nodose, uniformly dark brown. Wing-pattern very pale. Male hypopygium with ninth tergite (Fig. 30, G); eighth sternite (Fig. 30, F). Ovipositor pale, the cerci broad, their tips subacute. ♂. L. 12-15 mm.; w. 14-17 mm.; antenna, 5-5.5 mm. ♀. L. 12-13 mm.; w. 15-16 mm.

(May-July) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., N. J., westw. to Wisc., Ia. and Alta.

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 31, 1931 (C. P. A.), June 12-13, 1931 (C. P. A.); Riverton, May 30, 1931, June 12, 1931 (C. P. A.); Salisbury, June 10, 1928 (R. B. F.); Storrs, May 1929 (C. J. A.).

T. (*Oreomyza*) **serta** Lw. (Figs. 30, K).
1863. ? *Tipula discolor* Loew; Berlin. Ent. Zeitschr., 7: 282 (preoccupied).
1863. *T. serta* Loew; *Ibid.*, 7: 283.
1901. *T. albonotata* Doane; Journ. N. Y. Ent. Soc., 9: 120; Alexander, Can. Ent., 60: 97; 1928.
1915. ? *T. ignota* Alexander; Insec. Inscit. Menst., 3: 128 (new name for *discolor*).

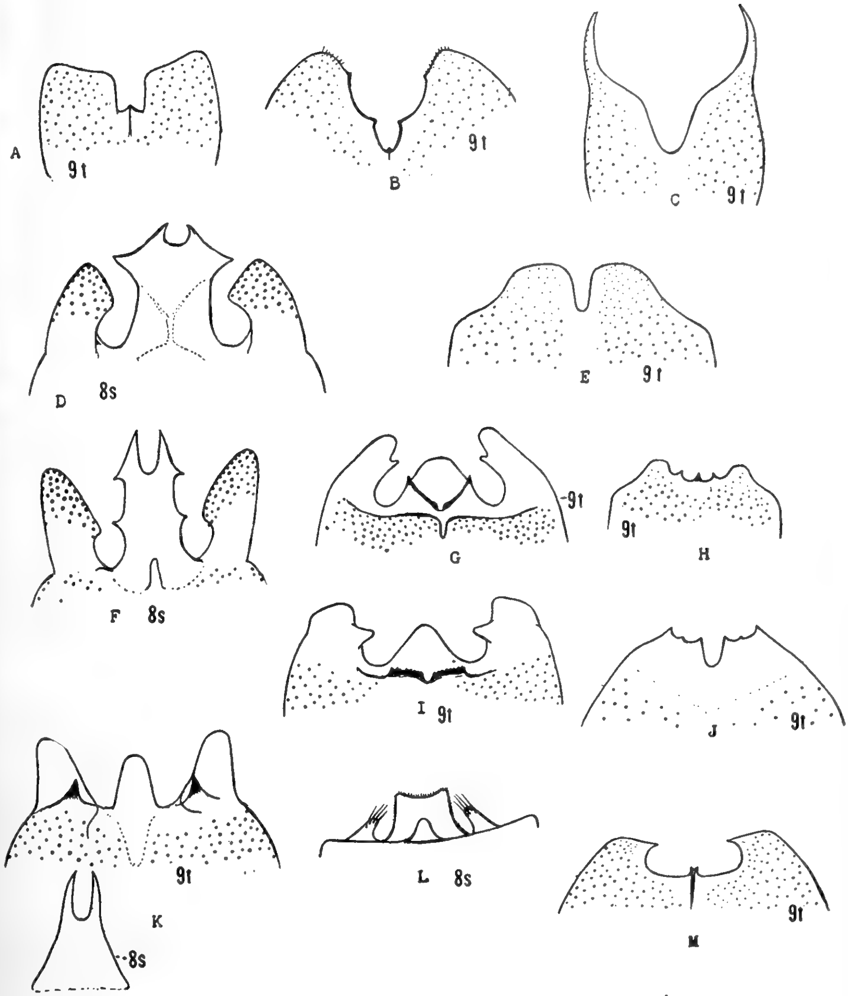


FIGURE 30. *Tipula (Oreomyza)*; male hypopygia.

A. *T. (O.) angulata* Lw.; 9*t*.
B. *T. (O.) entomophthorae* Alex.; 9*t*.
C. *T. (O.) huron* Alex.; 9*t*.
D. *T. (O.) illinoiensis* Alex.; 8*s*.
E. *T. (O.) margarita* Alex.; 9*t*.
F. *T. (O.) senega* Alex.; 8*s*.
G. *T. (O.) senega* Alex.; 9*t*.
H. *T. (O.) penobscot* Alex.; 9*t*.
I. *T. (O.) illinoiensis* Alex.; 9*t*.
J. *T. (O.) ternaria* Lw.; 9*t*.
K. *T. (O.) serta* Lw.; 8*s*, 9*t*.
L. *T. (O.) neptun* Alex.; 8*s*.
M. *T. (O.) trivittata* Say; 9*t*.

Symbols: *s*, sternite; *t*, tergite.

Figs.—Alexander, Cfls. N. Y., 1, pl. 50, fig. 277 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 234, fig. 148 (wing), p. 249, fig. 183 (hyp.); 1932.

Antennae (♂) with flagellar segments strongly nodose, uniformly darkened. Praescutum with four stripes that are narrowly bordered with brown. Wings brown, with three major white areas, including an incomplete band beyond cord and isolated areas near outer end of cell *M* and before midlength of cells *Cu* and *1st A*. Median dark stripe on abdominal tergites rarely obsolete. Tergite of hypopygium (Fig. 30, K, *9t*); appendage of eighth sternite (Fig. 30, K, *8s*). ♂. L. 15-16 mm.; w. 14-16 mm.; antenna, 5-5.5 mm. ♀. L. 18-23 mm.; w. 15-16 mm.

(Late May, June) Ont., Que., Lab., Me., N. H., Vt., Mass., R. I., N. Y., westw. to Minn., Wisc., Sask. and Alta.

Connecticut.—Portland, May 23, 1930 (M. P. Z.); Storrs, 1932 (C. S. C.); Unionville, June 10, 1904 (W. E. B.); Winsted, June 10, 1928 (R. B. F.).

T. discolor is here considered as being the same as *serta*. The wing-pattern of the unique female type is practically the same as in *serta* but the median praescutal stripe is entire.

T. (*Oreomyza*) **stylifera** Dtz.
1921. *Tipula stylifera* Dietz; Trans. Amer. Ent. Soc., 47: 264-265.

Praescutum with four grayish brown stripes that are narrowly margined with darker; interspaces with brown punctures. Pleura grayish white, variegated by pale brown areas. Femora dusky yellow, tips slightly darker. Pale crossband beyond cord extending to midlength of cell M_3. Abdominal tergites yellow, without median dark stripe except on segment two; lateral borders whitish; a vague sublateral darkening. ♂. L. 14 mm.; w. 18 mm.

(June) Pa. Still known only from the unique type.

T. (*Oreomyza*) **subfasciata** Lw.
1863. *Tipula subfasciata* Loew; Berlin. Ent. Zeitschr., 7: 282.

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 248 (wing); 1919. Dickinson, Cfls. Wisc., p. 232, fig. 140 (wing), p. 248, fig. 174 (hyp.); 1932.

Flagellar segments not excised. Head with median dark vitta. Legs yellowish brown, the individual segments undarkened. Wings narrow; *Rs* very long, nearly three times *m-cu*; petiole of cell M_1 short. The hypopygium as figured by Dickinson (possibly not correctly determined) is much as in *angulata* but median tergal notch without basal denticle. ♂. L. about 12 mm.; w. 15.5 mm.

Hudson's Bay Region; N. S., Wisc.

T. (*Oreomyza*) **neptun** Alex. (Fig. 30, L).
1921. *Tipula neptun* Dietz; Ent. News, 32: 300-301.
1928. *Tipula subserta* Alexander; Can. Ent., 60: 97.

Close to *serta*, differing most decisively in hypopygial characters. Abdominal tergites rich reddish brown, the median stripe lacking.

Eighth sternite (Fig. 30, L). ♂. L. 13-15 mm.; w. 14-15 mm.; antenna, 4.5-5 mm. ♀. L. 18 mm.; w. 13.5 mm.

(June, July) Que., Lab., Me. (Mt. Katahdin, summit), westw. to Colo., Wyo., Mont. and Alaska. (Hudsonian).

T. (*Oreomyza*) **ternaria** Lw. (Fig. 30, J).
1864. *Tipula ternaria* Loew; Berlin. Ent. Zeitschr., 8:57.

Fig.—Alexander, Cfls. N. Y., 1, pl. 50, fig. 282 (hyp.); 1919.

Praescutal stripes dark gray, the median one margined and divided medially by capillary dark vittae. Femora reddish, the tips blackened. Male hypopygium large; tergite (Fig. 30, J) broad, narrowed outwardly, the caudal third reddish, depressed; lobes with three microscopic denticles. Eighth sternite with a small brush of yellow setae, widely separated by median area. ♂. L. 13-17.5 mm.; w. 13-15.5 mm. ♀. L. 24 mm.; w. 18 mm.

(June) Ont., Que., N. B., Me., N. H., westw. to Alta. (Hudsonian).

T. (*Oreomyza*) **trivittata** Say. (Fig. 30, M).
1823. *Tipula trivittata* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:26.
1856. *T. simulata* Walker; Ins. Saundersiana, 1, Dipt., p. 441; Alexander, Brooklyn Ent. Soc., 25:277.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 18, figs. 150-153 (hyp.); 1904. Greene, Ent. News, 20:289, pl. 12 (ad. ♀); 1909. Alexander, Cfls. N. Y., 1, pl. 46, fig. 226 (wing), pl. 51, fig. 294 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 231, fig. 139 (wing), p. 248, fig. 173 (hyp.); 1932.

Median praescutal stripe extensively pale in center. Femoral tips narrowly darkened. Abdominal tergites with three more or less distinct brown stripes, lateral margins gray. Tergite of hypopygium (Fig. 30, M). ♂. L. 14-18 mm.; w. 16-19 mm.; antenna, 4-4.5 mm. ♀. L. 20-22 mm.; w. 20-22 mm.

(May-Aug.) Ont., Que., Nfd., N. B., N. S., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc. and Ia., southw. to N. C., S. C. and Tenn.

Connecticut.—Branford, June 16, 1904 (H. L. V.); Granby, June 8, 1929 (C. P. A.); Hamden, April 23, 1924 (larva), emerged June 6, 1924 (J. L. R.), June 2, 1928 (R. B. F.); Kent Falls, May 31, 1931, June 12-13, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Middlebury, June 2, 1929 (W. E. B.); New Haven, May 27, 1929 (W. E. B.), June 18, 1933 (W. E. B.); Salem, June 12, 1929 (R. B. F.); Stamford, May 31, 1929 (B. T. R. L.); Stonington, June 7, 1906 (W. E. B.); Storrs, May 1928, 1929 (G. H. G.); Suffield, June 10, 1915 (B. H. W.); Union, June 24, 1932 (N. T.); Wading River, July 1, 1915 (G. P. E.); West Hartford, June 10, 1929 (R. B. F.); Westville, June 11, 1905 (W. E. B.).

Subgenus **Lunatipula** Edwards

1931. *Lunatipula* Edwards; Ann. Mag. Nat. Hist., (10) 8:81-82.

Rs variable in length, ranging from subequal to *m-cu* to fully twice this length; R_{1+2} entire. Squama with a group of setae. Veins beyond cord with trichia. Tibial spur formula 1-2-2; claws (♂) with

basal tooth. Male hypopygium with tergite and sternite distinct; 8th sternite usually provided with fleshy lobes, tufts of setae or hair-pencils. Ovipositor with cerci long and slender, smooth; in *bicornis* group, all valves short and fleshy.

Includes the majority of the so-called "Subunicolores", having the wings unmarked or virtually so, and with the obliterative area at the cord forming a conspicuous lunule against the ground color.

Key to Groups

1. Wings with cell *1st* M_2 open by atrophy of *m*........*aperta* (*dorsimacula* group)
   Wings with cell *1st* M_2 closed 2
2. Wings with cell *1st* M_2 very small, pentagonal, the upper face (second section of M_{1+2}) shorter than or subequal to the petiole of cell M_1; ovipositor with short fleshy cerci; male hypopygium enlarged, the tergite variously armed with fleshy lobes (except in *johnsoniana*); 8th sternite without fleshy lobes ....*bicornis* group
   Wings with cell *1st* M_2 normally elongated, the upper face (second section of M_{1+2}) exceeding the petiole of cell M_1; ovipositor with slender sclerotized cerci; male hypopygium variously constructed, if tergite bears fleshy horns, the 8th sternite armed with lobes 3
3. Male hypopygium with the basistyle produced caudad into a long spatulate blade; wings with two large dark areas basad of the stigmal darkening, these inter-connected by a pale brown wash in cell *R*........*macrolabis* group
   Male hypopygium with the basistyle not produced into a long spatulate blade; wings rarely with a dark pattern, where this most conspicuous (*fuliginosa, disjuncta,* ♀) the wing-surface chiefly or entirely dark brown or blackened, or (*fuliginosa,* ♂; *dorsimacula*) without a well-defined dark area basad of origin of *Rs*.. 4
4. Male hypopygium asymmetrical, the right basistyle produced caudad into a conspicuous 2-cleft arm (Fig. 31, I); female with wing chiefly dark brown or blackish, variegated with whitish along cord and beyond stigma........ *fuliginosa* group
   Male hypopygium symmetrical; female without blackened wings (except in *disjuncta,* where these are uniformly darkened)...........*dorsimacula* group

The *bicornis* or *fascipennis* group.

Nasus short. Antennae of moderate length; flagellum usually more or less bicolored. Wings with cell *1st* M_2 small, pentagonal. Male hypopygium with ninth tergite usually tumid. Ovipositor with small fleshy cerci.

Key to Species

1. Cell *1st* M_2 very small, the cephalic face (second section of M_{1+2}) shorter than petiole of cell M_1.. 2
   Cell *1st* M_2 more elongate, its outer end pointed; cephalic face subequal to or even slightly longer than petiole of cell M_1 6
2. Second section of vein M_{1+2} with macrotrichia........................**parshleyi**
   Second section of vein M_{1+2} without macrotrichia, pale and included in the obliterative streak 3
3. Cells *C* and *Sc* strongly infumed; veins comprising outer end of cell *1st* M_2 not obliterated ....**morrisoni**
   Cells *C* and *Sc* not or but slightly darkened; veins comprising cell *1st* M_2, with the exception of M_{3+4}, pale and semi-obliterated.................. 4
4. Cell *1st* M_2 entirely pale ....**megaura**
   Cell *1st* M_2 with both ends more or less darkened 5
5. Vestiture of thorax relatively short ....**parshleyi**
   Vestiture of thorax long and conspicuous ....**bicornis**

6. Cells *C* and *Sc* strongly infumed, approximately as dark as the stigma; antennal flagellum weakly bicolored .... **morrisoni**
   Cells *C* and *Sc* pale yellow, much lighter than the stigma; antennal flagellum uniformly dark brown .... **johnsoniana**

(*Supplementary Key: Males*)

1. Hypopygium (Fig. 31, E) with 9th tergite not or scarcely tumid, the slender horns directed caudad; 8th sternite long, sheathing the 9th sternite, at apex with two horny points on either side .... **parshleyi**
   Hypopygium with 9th tergite tumid, with or without horns; 8th sternite shorter, not sheathing the 9th sternite, unarmed at apex 2
2. Ninth tergite with four lobes or horns (Fig. 31,C) .... **megaura**
   Ninth tergite with two horns or else without horns 3
3. Tergite of hypopygium without horns (Fig. 12, B) .... **johnsoniana**
   Tergite with horns 4
4. Horns of tergite slender, directed dorsad and caudad (Fig. 31, A) ...... **bicornis**
   Horns of tergite stout, directed caudad and very slightly ventrad (Fig. 31, D) **morrisoni**

Tipula (*Lunatipula*) **bicornis** Forbes. (Figs. 24, H; 31, A).
1891. *Tipula bicornis* Forbes; State Ent. Illinois, Rept. 16: 78.

Figs.—Snodgrass, Journ. N. Y. Ent. Soc., 11, pl. 10, fig. 1, pl. 11, fig. 16 (ovipos.); 1903; Trans. Amer. Ent. Soc., 30, pl. 14, figs. 94-101 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 46, fig. 230 (wing), pl. 52, fig. 319, pl. 55, fig. 350 (hyp.); 1919. Cole, Proc. California Acad. Sci. (4) 16:459, fig. 8 (hyp.); 1927. Dickinson, Cfls. Wisc., p. 250, fig. 196 (hyp.); 1932.

Ground color of thorax light gray, praescutum with four more brownish stripes. Male hypopygium (Fig. 31, A) with dorsal angle of basistyle produced into a spine. ♂. L. 12-13 mm.; w. 14-15 mm.

(May-early July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., Kan. and Mo., southw. to Va. and Tenn. (Transition).

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.); Storrs, 1929.

T. (*Lunatipula*) **johnsoniana** Alex. (Fig. 31, B).
1915. *Tipula johnsoniana* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 505-506.
1915. *T. winnemana* Alexander; Insec. Inscit. Menst., 3: 136-137.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1915, pl. 17, fig. 20 (wing), pl. 18, fig. 40, pl. 19, fig. 58 (hyp.); 1915. Alexander, Cfls. N. Y., 1, pl. 52, fig. 318, pl. 55, fig. 351 (hyp.); 1919.

Praescutal stripes grayish brown, the median one entire. Male hypopygium (Fig. 31, B). ♂. L. 17.5-19.5 mm.; w. 19-22.8 mm.

(June, July) Vt., Mass., southw. to Md. (Transition).

T. (*Lunatipula*) **megaura** Doane. (Fig. 31, C).
1901. *Tipula megaura* Doane; Journ. N. Y. Ent. Soc., 9: 112-113.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1915, pl. 17, fig. 22 (wing), pl. 18, fig. 42, pl. 19, fig. 59 (hyp.); 1915. Alexander, Cfls. N. Y., 1, pl. 46, fig. 231 (wing), pl. 52, fig. 320, pl. 55, fig. 353 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 238, fig. 158 (wing), p. 250, fig. 195 (hyp.); 1932.

Antennae relatively short; flagellum very weakly bicolorous.

Praescutal stripes reddish brown. Male hypopygium (Fig. 31, C). ♂. L. 12.5-15 mm.; w. 14.5-16 mm. ♀. L. 16-18 mm.; w. 16 mm.

(June, July) Ont., Que., Vt., westw. to Mich., Wisc., Minn. and Ia. (Canadian).

T. (*Lunatipula*) **morrisoni** Alex. (Fig. 31, D).
1915. *Tipula morrisoni* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 507-508.

Figs.—Alexander, *Ibid.*, pl. 17, fig. 21 (wing), pl. 18, fig. 41, pl. 21, figs. 82, 83 (hyp.). Alexander, Cfls. N. Y., 1, pl. 45, fig. 352 (hyp.); 1919.

Antennae indistinctly bicolorous. Coloration yellow, the praescutal stripes slightly darker. Male hypopygium (Fig. 31, D) chiefly yellowish; ventro-caudal angles of tergite produced into irregularly toothed points. ♂. L. 13-15 mm.; w. 18-19 mm. ♀. 15-16 mm.; w. 15 mm.

(May-early July) Mass., R. I., N. Y., N. J., Del., westw. to Ill. and Kan., southw. to S. C., Ky. and Miss. (Transition, Austral).

T. (*Lunatipula*) **parshleyi** Alex. (Fig. 31, E).
1915. *Tipula parshleyi* Alex.; Proc. Acad. Nat. Sci. Philadelphia, 1915: 510-512.

Figs.—Alexander, *Ibid.*, pl. 17, fig. 23 (wing); pl. 18, fig. 43, pl. 19, fig. 60, pl. 20, fig. 74 (hyp.); pl. 21, fig. 87 (ovipos.). Alexander, Cfls. N. Y., 1, pl. 52, fig. 321, pl. 55, fig. 354 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 250, fig. 193 (hyp.); 1932.

Antennae with flagellar segments bicolorous. Coloration dull yellow, the praescutal stripes relatively indistinct, dull orange to brown. Male hypopygium (Fig. 31, E). ♂. L. 13.5-15 mm.; w. 15-17 mm. ♀. L. 14-15 mm.; w. 16.5-17.5 mm.

(June, July) Ont., Que., N. B., N. S., Me., Vt., N. H., Mass., N. Y., westw. to Wisc., Minn. and Colo. (Canadian).

The *macrolabis* group.

The long paddle-like blades of the basistyles readily separate the members of this group; unfortunately there seem to be no correlated characters in the female sex. Dark area in cell R_2 of wings usually not quite reaching margin. Praescutal stripes four, entire.

Key to Species

1. Male hypopygium with the apex of paddle-like blade of basistyle (Fig. 31, F) smooth; tergite with a flattened divergent lobe on either side of median tooth .... **macrolabis**
   Male hypopygium with apex of paddle-like blade of basistyle (Fig. 31, G) terminating in two or three acute spines; tergite with caudal margin more truncate, with a sharp median tooth .... **youngi**

Tipula (*Lunatipula*) **macrolabis** Lw. (Fig. 31, F).
1864. *Tipula macrolabis* Loew; Berlin. Ent. Zeitschr., 8: 58.
1918. *T. macrolaboides* Alexander; Can. Ent., 50: 69-70.

Figs.—Alexander, Cfls. N. Y., 1, pl. 51, fig. 296, pl. 53, fig. 323 (hyp.); 1919 (as *macrolaboides*).

FIGURE 31. *Tipula (Lunatipula)*; male hypopygia.

A. *T. (L.) bicornis* Forbes; lateral aspect.
B. *T. (L.) johnsoniana* Alex.; the same.
C. *T. (L.) megaura* Doane; the same.
D. *T. (L.) morrisoni* Alex.; the same.
E. *T. (L.) parshleyi* Alex.; the same.
F. *T. (L.) macrolabis* Lw.; *b.*
G. *T. (L.) youngi* Alex.; *b.*
H. *T. (L.) fuliginosa* (Say); 9*t.*
I. *T. (L.) fuliginosa* (Say); right basistyle.
J. *T. (L.) apicalis* Lw.; 9*t.*
K. *T. (L.) australis* Doane; 8*s.*
L. *T. (L.) disjuncta* Walk.; 9*t.*
M. *T. (L.) dorsimacula* Walk.; 9*t.*
N. *T. (L.) dietziana* Alex.; 8*s.*
O. *T. (L.) duplex* Walk.; 9*t.*
P. *T. (L.) eriensis* sp. nov.; 9*t.*

Symbols: *b,* basistyle; *id,* inner dististyle; *s,* sternite; *t,* tergite.

Antennal flagellum clearly to vaguely bicolorous. Apex of basistyle (Fig. 31, F). ♂. L. 15-17 mm.; w. 17-18 mm.; antenna, about 4.5 mm. ♀. L. 17-18 mm.; w. 18-19 mm.

(July, Aug.) Lab., Lake Superior region of Mich., westw. across subarctic North America, to Alaska, southw. along higher Rockies to N. M., crossing Bering Straits to Kamchatka. (Hudsonian).

T. (*Lunatipula*) **youngi** Alex. (Fig. 31, G).
1927. *Tipula youngi* Alexander; Can. Ent., 59:218-219.

Figs.—Alexander, Cfls. N. Y., 1, pl. 47, fig. 233 (wing); pl. 51, fig. 295, pl. 53, fig. 322 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 233, fig. 144 (wing); p. 249, fig. 179 (hyp.); 1932.

Antennal flagellum clearly bicolorous. Praescutal stripes narrow, punctures on interspaces indicated. Apex of basistyle (Fig. 31, G). ♂. L. 17-19 mm.; w. 15-19 mm.; antenna, about 4.5-5 mm. ♀. L. 17-18 mm.; w. 18-19 mm.

(June-Aug.) N. S., Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Mich., Wisc. and Alta. (Canadian).

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.).

The *fuliginosa* group.

Tipula (*Lunatipula*) **fuliginosa** (Say). (Figs. 31, H, I).
1823. *Ctenophora fuliginosa* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:18 (♀).
1863. *Tipula speciosa* Loew; Berlin. Ent. Zeitschr., 7:288 (♂); Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1915:479-480.

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 245 (wing ♂), fig. 246 (wing ♀); pl. 51, fig. 289 (hyp.); 1919.

Sexes strongly dimorphic in color. Antennae bicolorous, relatively short. *Male.* Bright orange, praescutum undarkened. Wings yellow basally, more clouded with brown apically; small brown spots at arculus and origin of *Rs*, with a vague wash in cell *R* between the two areas. Hypopygium asymmetrical, right basistyle produced caudad as a prominent bispinous arm (Fig. 31, I); left basistyle terminating in a small spine. Ninth tergite (Fig. 31, H). *Female.* Much darker, the praescutum with four pale brown stripes that are narrowly bordered by darker. Wings blackened, variegated by whitish before and at cord and beyond stigma. Abdominal tergites obscure orange with three conspicuous brownish black stripes. ♂. L. 15-16 mm.; w. 18-20 mm.; antenna, 4.5-5 mm. ♀. L. 16-17 mm.; w. 15-16 mm.

(June, July) Ont., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Mo. and Kan., southw. to N. C., Ky. and Tenn. (Transition, Austral).

Connecticut.—Hamden, June 11, 1914 (W. E. B.), June 2, 1928 (R. B. F.); Montville, June 12, 1929 (W. E. B.); New Haven, June 5, 1904 (H. L. V.); Rowayton, June 16, 1909 (C. W. J.); Storrs, 1932; W. Hartford, June 10, 1929 (R. B. F.); Winnipauk, June 12, 1915 (C. W. J.).

The *dorsimacula* group.

Key to Species

1. Cells beyond cord of wing darkened, conspicuously variegated by whitish in radial cells beyond the stigma 2
   Cells beyond cord of wing uniformly colored, subhyaline or suffused with yellow or brownish yellow, not with a white post-stigmal area (*subunicolores*); compare also *australis* and *dietziana* which may in cases be interpreted as falling under couplet la 11
2. Wing-apex narrowly but conspicuously darkened, the remainder of disk clear or virtually so .... **apicalis**
   Wing-apex not abruptly darkened and with remainder of surface clear.... 3
3. Cells basad of cord strongly infumed, cells *M* to *A* variegated by whitish areas (*dorsimacula* subgroup) 4
   Cells basad of cord uniformly pale in color 6
4. Flagellar segments uniformly blackened .... **dorsimacula**
   Flagellar segments bicolorous 5
5. Bases of flagellar segments yellow, the remainder darkened; male hypopygium with eighth sternite simple .... **beaulieui**
   Bases of flagellar segments brownish black, slightly darker than remainder of segments; male hypopygium with eighth sternite armed with brushes of setae .... **eriensis**
6. Size large (wing, ♂; over 20 mm.); (*valida* subgroup) 7
   Size smaller (wing, ♂, less than 18 mm.) 8
7. Male hypopygium with a median tuft of long yellow setae on eighth sternite; tergal horns short and inconspicuous .... **hirsuta**
   Male hypopygium without a brush of long yellow setae on eighth sternite; tergal horns longer, prominent .... **valida**
8. Antennal flagellum bicolorous; dark wing-pattern heavier; a dark spot at origin of *Rs* and darker seams on *m-cu* and outer section of Cu_1; (*submaculata* subgroup) 9
   Antennal flagellum uniformly darkened; dark wing-pattern greatly reduced or virtually restricted to the stigmal darkening; no dark seams at origin of *Rs* or on *m-cu* or Cu_1; Subarctic species.......... 10
9. Male hypopygium with tergal horns short; posterior lobe of inner dististyle broad, the apex truncated; gonapophyses with apical points not angularly bent .... **mallochi**
   Male hypopygium with tergal horns (Fig. 32, I) long and slender; posterior lobe of inner dististyle produced into a slender point or with apex bifid; gonapophyses with outer ends angularly bent into long slender points.... **submaculata**
10. Male hypopygium with basistyle produced caudad into a flattened lobe..**loewiana**
    Male hypopygium with basistyle simple .... **penicillata**
11. Cell *1st* M_2 open by atrophy of *m* .... **aperta**
    Cell *1st* M_2 closed 12
12. Antennae with bases of flagellar segments light yellow, the remainder black **flavibasis**
    Antennae with flagellum, if bicolorous, with bases of segments darker than remainder 13
13. Antennae (♂) unusually elongate, if bent backward extending about to the fourth abdominal segment; wings (♀) uniformly brownish black or dark brown; hypopygium (♂) unarmed with lobes or pencils.......... **disjuncta**
    Antennae shorter, in ♂ not extending caudad beyond base of abdomen; wings of both sexes pale, unblackened; hypopygium (♂) provided with lobes or hair-pencils 14
14. Male hypopygium with caudal margin of tergite having two rounded emarginations, one on either side of a double median spinous point (Fig. 32, K); 8th sternite with median area provided with two parallel-sided sclerotized teeth (Fig. 32, A, G, J) (*triplex* subgroup).......... 15
    Male hypopygium without the appearance of two rounded emarginations on caudal margin of tergite; if with a median lobe, this entire (Fig. 32, B, E, M); 8th sternite without two submedian sclerotized teeth 17

15. Submedian teeth of 8th sternite triangular in outline, broad basally, narrowed outwardly (Fig. 32, A); wings broad, distal section of Cu_1 and *m-cu* narrowly and sometimes very vaguely seamed with brown...... **flavoumbrosa**
Submedian teeth of 8th sternite slender, parallel-sided, separated from one another by a broad U-shaped notch (Fig. 32, G, J); wings narrower, *Cu* and *m-cu* not seamed with darker 16
16. Male hypopygium with 8th sternite having a median depressed lobe arising ventrad and slightly cephalad of the usual submedian teeth (Fig. 32, G) **perlongipes**
Male hypopygium with 8th sternite having only the submedian teeth (Fig. 32, J) .... **triplex**
17. Ground color of mesonotum gray or grayish, the praescutum with brown stripes; pleura light gray 18
Ground color of mesonotum brownish or yellow; pleura yellow, in cases with a thin white pruinosity 20
18. Wings with costal region and a seam along vein *Cu* conspicuously darker than the ground color; cell *1st* M_2 short, the second section of vein M_{1+2} less than twice the basal section; antennae short........ **catawba**
Wings without conspicuous darkening in costal region or along vein *Cu*; cell *1st* M_2 long, the second section of M_{1+2} nearly three times the basal section; antennae longer 19
19. Antennae of moderate length; flagellar segments beyond basal enlargements deeply constricted; praescutal stripes bordered by darker to produce the appearance of six narrow vittae; male hypopygium with eighth sternite armed with four conspicuous lobes (Fig. 31, K)........ **australis**
Antennae longer; flagellar segments not constricted beyond basal enlargement; praescutum with three brown stripes, at least the lateral pair entire; male hypopygium with eighth sternite merely bilobed (Fig. 31, N).. **dietziana**
20. Praescutum yellow with conspicuous brown stripes; caudal margin of tergite of hypopygium with a broad V-shaped notch, the lobes divergent, dark-colored, bordered by pale yellow (Fig. 32, D)........ **mainensis**
Coloration not as above, the praescutal stripes not dark brown; hypopygium with tergite not notched as described 21
21. Male hypopygium with ninth tergite (Fig. 32, M) trifid, with three pointed lobes, the median one smaller; outer dististyle fleshy and setiferous, the apex a short acute point .... **triton**
Male hypopygium with ninth tergite not trifid; if with a median protuberance, this low and obtuse; outer dististyle not as above........ 22
22. Male hypopygium with lateral lobes of tergite produced into long curved horns; no median lobule; outer dististyle produced into a long blackened hook .... **tuscarora**
Male hypopygium without long curved tergal horns; outer dististyle not produced into a blackened hook 23
23. Lateral lobes of ninth tergite very broad and obtuse, somewhat truncated (Fig. 31, O) .... **duplex**
Lateral lobes of ninth tergite not truncated, either pointed (Fig. 32, E, H, L) or evenly rounded (Fig. 32, B) 24
24. Hypopygium with lateral lobes of ninth tergite rounded (Fig. 32, B).. **georgiana**
Hypopygium with lobes of tergite acute or subacute, not evenly rounded (Fig. 32, E, H, L) 25
25. Abdominal tergites two to five, inclusive, each with a brown spot on lateral portion near base .... **seminole**
Abdominal tergites without such rows of brown spots 26
26. Praescutum opaque, with distinct stripes; wings gray, the obliterative streak at cord inconspicuous; hypopygium with tergite having a median lobe in addition to the subacute lateral lobes; eighth sternite without enlarged spinous setae, provided with two large lobes that bear large tufts of silvery setae .... **monticola**
Praescutum polished yellow or orange-yellow, without distinct stripes; wings strongly suffused with brown, the obliterative streak very conspicuous; hypopygium with lateral tergal lobes only; eighth sternite with an enlarged spinous seta on either side........ **translucida**

Tipula (*Lunatipula*) **aperta** Alex.
1915. *Tipula imperfecta* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 484-485 (preoccupied).
1918. *T. aperta* Alexander; Can. Ent., 50: 62.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1915, pl. 16, fig. 9 (wing); pl. 21, fig. 86 (ovipos.); 1915. Alexander, Cfls. N. Y., 1, pl. 47, fig. 235 (wing): 1919.

Coloration grayish brown, praescutal stripes indistinct. Ovipositor with cerci relatively wide, feebly sclerotized, lying transversely. ♀. L. 11 mm.; w. 10.5 mm.

Lab. (Hudsonian).

T. (*Lunatipula*) **apicalis** Lw. (Fig. 31, J).
1863. *Tipula apicalis* Loew; Berlin. Ent. Zeitschr., 7: 277.

Figs.—Alexander, Cfls. N. Y., 1, pl. 48, fig. 254 (wing); pl. 51, fig. 302, pl. 54, fig. 342 (hyp.); 1919.

Flagellum uniformly brownish black. General coloration yellow; praescutal stripes three, brown. Male hypopygium with tergite (Fig. 31, J) notched, the lateral lobes glabrous; a small median lobule; on ventral surface of each lateral lobe a small acute spine directed mesad. Basistyle produced into a setiferous lobe. ♂. L. 11-13 mm.; w. 12.5-14 mm.; antenna, about 4 mm. ♀. L. 15-16 mm.; w. 14-15 mm.

(Late May-early Aug.) Ont., Que., N. S., Me., N. H., Mass., N. Y., westw. to Mich., southw. to N. C. and Tenn. (Canadian, Transition).

Connecticut.—Kent Falls, June 12, 13, 1931 (C. P. A.); W. Granby, June 8, 1929. near mossy cliff (C. P. A.).

T. (*Lunatipula*) **australis** Doane. (Fig. 31, K).
1901. *Tipula australis* Doane; Journ. N. Y. Ent. Soc., 9: 104-105.

Figs.—Alexander, Cfls. N. Y., 1, pl. 52, fig. 305, pl. 53, fig. 326 (hyp.); 1919.

Flagellum uniformly darkened. Male hypopygium, 8th sternite (Fig. 31, K). ♂. L. 14 mm.; w. 14 mm. ♀. L. 17 mm.; w. 14 mm.

(Mar., Apr.) Va., Md., N. C., S. C., Ga., westw. to La. and Tex. (Austral).

T. (*Lunatipula*) **beaulieui** Dtz.
1921. *Tipula beaulieui* Dietz; Ent. News, 32: 301-302.

Close to *dorsimacula*. Antennae relatively short. Praescutal stripes brown, margined with darker. No dark spot at origin of *Rs*. Abdomen orange-yellow, tergites with three dark brown stripes. Male hypopygium very much as in *dorsimacula*. ♂. L. 15 mm.; w. 14 mm.

Ont.

Known only from the unique type. Very questionable whether it is distinct from *dorsimacula*.

T. (*Lunatipula*) **catawba** Alex.
1915. *Tipula catawba* Alexander; Insec. Inscit. Menst., 3:134-136.

Antennae short: flagellum uniformly darkened. Praescutal stripes four, entire; in female, with a capillary median vitta. Hypopygium with 9th tergite much as in *georgiana*; lateral lobes subacute; 8th sternite with a long median fringe of golden yellow setae. ♂. L. 13 mm.; w. 12.5 mm.; antenna, about 3.3 mm. ♀. L. 15 mm.; w. 12.5 mm.

(Apr.) N. C., S. C.

T. (*Lunatipula*) **dietziana** Alex. (Fig. 31, N).
1915. *Tipula dietziana* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:501-504.

Figs.—Alexander, Cfls. N. Y., 1, pl. 47, fig. 238 (wing); pl. 52, fig. 306, pl. 53, fig. 327 (hyp.); 1919.

Median praescutal stripe often more or less divided by pale color and further split by a capillary dark line; lateral stripes entire. Eighth sternite (Fig. 31, N). ♂. L. 13-15 mm.; w. 15.5-17 mm.; antenna, about 6-6.2 mm. ♀. L. 20-22 mm.; w. 17-18 mm.

(Apr., early May) N. J., Pa., Md., Va., westw. to Ind. and Kan., southw. to S. C. and Tenn. (Austral).

T. (*Lunatipula*) **disjuncta** Wk. (Fig. 31, L).
1856. *Tipula disjuncta* Walker; Ins. Saundersiana, 1, Dipt., 442.
1915. *T. taughannock* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:476-479.

Figs.—Alexander, *Ibid.*, pl. 16, figs. 7, 8 (wing, ♂, ♀); pl. 18, fig. 33, pl. 19, fig. 47, pl. 20, fig. 62 (hyp.). Alexander, Cfls. N. Y., 1, pl. 48, fig. 244 (wing, ♀); pl. 51, fig 290, pl. 53, fig. 336 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 238, fig. 157 (wing); p. 250, fig. 194 (hyp.); 1932.

Sexes strongly dimorphic in color. *Male.* Thoracic dorsum yellowish, with three brown stripes. Basal flagellar segments bicolorous, the outer ones brown or black. Wings brownish subhyaline. Abdominal tergites yellow, interruptedly trivittate with brown. Ninth tergite (Fig. 31, L); basistyle produced caudad into a slender blade. *Female.* Wings tending to be reduced in size. General coloration brownish black, abdominal tergites and sternites with a bright yellow median vitta, in cases more or less interrupted. ♂. L. 15-17 mm.; w. 14.5-16 mm.; antenna, about 8-9 mm. ♀. L. 15-19 mm.; w. 9.5-12.5 mm.

(May, June) Ont., Vt., N. Y., N. J., Del., Pa., westw. to Ill., Wisc. and Ia. (Transition).

T. (*Lunatipula*) **dorsimacula** Wk. (Fig. 31, M).
1848. *Tipula dorsimacula* Walker; List Dipt. Brit. Mus., 1:69; Alexander, Bull. Brooklyn Ent. Soc., 25:276; 1930.
1863. *T. angustipennis* Loew; Berlin. Ent. Zeitschr., 7:286.

Figs.—Snodgrass, Journ. N. Y. Ent. Soc., 11, pl. 10, figs. 2, 5, 7-10 (ovipos.); 1903. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 17, figs. 139-149 (hyp.); 1904.

Alexander, Cfls. N. Y., 1, pl. 45, fig. 212 (wing); pl. 50, fig. 276 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 235, fig. 151 (wing); p. 249, fig. 185 (hyp.); 1932.

Antennae stout; flagellar segments not or scarcely excised; bases of segments sometimes slightly reddish. Praescutal stripes dark gray, narrowly margined with brown. White spots in cells *M* and bases of *Cu* and *1st A* conspicuous. Abdominal tergites orange, trivittate with black, the stripes sometimes more or less interrupted. Male hypopygium with tergite (Fig. 31, M) pale yellow, the lobes broadly obtuse, separated by a narrow V-shaped notch; posterior appendage of inner dististyle large and pale, bilobed at apex. ♂. L. 15-18 mm.; w. 14-19 mm.; antenna, 6.5-7 mm. ♀. L. 20-25 mm.; w. 13-16 mm.

(Apr.-early July) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Colo., Mont., Utah, Cal. and B. C.

Connecticut.—Ansonia, May 2, 1914 (W. E. B.); Lyme, May 14, 1911 (A. B. C.); New Haven. Apr. 29, 1925 (W. E. B.); Storrs, May 1931, 1932; Wallingford, May 4, 1926 (J. L. R.). Connecticut, no further data, part of type material of *angustipennis* Loew.

T. (*Lunatipula*) **duplex** Wk. (Fig. 31, O).

1848. *Tipula duplex* Walker; List Dipt. Brit. Mus., 1:66; Alexander, Bull. Brooklyn Ent. Soc., 25:276; 1930.
1901. *T. cinctocornis* Doane; Journ. N. Y. Ent. Soc., 9:110.
1915. *T. mingwe* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915:490-492.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 13 (wing); pl. 20, fig. 68 (hyp.). Alexander, Cfls. N. Y., 1, pl. 47, fig. 242 (wing), pl. 52, fig. 310 (hyp.); 1919.

Antennae strongly bicolorous. General coloration yellow; praescutal stripes poorly indicated. Male hypopygium with tergite (Fig. 31, O); inner dististyle with outer appendage elongate, terminating in an acute spine. ♂. L. 16-17 mm.; w. 18-20 mm. ♀. L. 20-22 mm.; w. 16-17 mm.

(July-Sept.) Ont., Que., N. S., N. H., Vt., Mass., N. Y., N. J., Del., westw. to Ill., Mich., Mo. and Kan., southw. to Tenn. and n. Fla. (Transition, Austral).

T. (*Lunatipula*) **eriensis** sp. nov. (Fig. 31, P).

General appearance most like *dorsimacula*. Nasus very small to virtually lacking. Antennae more slender, with flagellar segments feebly excised; basal segments yellow, beyond the second flagellar weakly bicolored, brownish yellow, the basal enlargements darker, brown; outer segments more uniformly darkened.

Mesonotal praescutum yellowish gray, with four more brownish gray stripes, the laterals and posterior end of submedian stripes narrowly bordered by still darker brown; a capillary median dark vitta indicated on cephalic third of sclerite; setigerous punctures brown; scutal lobes variegated with darker; mediotergite yellow. Pleura weakly pruinose. Legs yellow, the femoral tips narrowly and insensibly darkened; tarsi dark brown. Wings strongly tinged with brown, variegated with darker brown and whitish; the restricted

darker areas are on anterior cord, at origin of *Rs* and a linear streak in base of *1st A*; whitish areas include a post-stigmal brightening; a conspicuous obliterative area before cord, extending into bases of cells M_3 and M_4; spots at base and near midlength of cells *Cu* and *1st A*; bases of cells *R* and *M* brightened; cell M_1 somewhat suffused with whitish.

Abdominal tergites brownish yellow, with a median brown stripe that is narrowly interrupted at posterior margins of segments; sublateral stripes obsolete; lateral borders not conspicuously pale; basal sternites gray. Male hypopygium with the tergite (Fig. 31, P) narrowed, with a conspicuous darkened median lobe, in addition to the subequal lateral yellow lobes. Outer dististyle flattened, widest at near midlength. Posterior appendage of inner dististyle conspicuous but relatively narrow, pale yellow, the apex simple and obtuse. Eighth sternite with lateral lobes short, provided with a pencil of long curved bristles; median area feebly emarginate to transverse, provided with numerous yellow setae. ♂. L. about 16 mm.; w. 16.5 mm.; antenna, about 5.5 mm.

Holotype, ♂, Sandusky, Ohio, June 17, 1926 (D. Lacroix); in author's collection.

T. (*Lunatipula*) **flavibasis** Alex.
1918. *Tipula flavibasis* Alexander; Can. Ent., 50:414-415.

General coloration yellowish brown, without well-indicated praescutal stripes. Antennae (♂) elongate, if bent backward extending to beyond base of abdomen. Male hypopygium with tergite notched; lateral lobes flattened, subacute, slightly divergent; a small acute median tooth at base of notch. ♂. L. 11.5-12 mm.; w. 12-12.7 mm.; antenna, 4.5-5 mm. ♀. L. 15-16 mm.; w. 12.3-13.5 mm.

(Late June-Sept.) Ind., westw. to Kan. (Austral).

T. (*Lunatipula*) **flavoumbrosa** Alex. (Fig. 32, A).
1918. *Tipula flavoumbrosa* Alexander; Can. Ent., 50:415-416.

Differs from *triplex* in the large size, yellow coloration of body, very broad wings, and details of the hypopygium especially the broad, triangular submedian teeth of the 8th sternite (Fig. 32, A). ♂. L. 22 mm.; w. 21.5-23.5 mm.; antenna, 6.5-7 mm. ♀. L. 21-22 mm.; w. 18 mm.

(Late May, June) Ohio, Ind., Ill., Mich. and Kan., southw. to S. C., Tenn. and n. Fla. (Austral).

T. (*Lunatipula*) **georgiana** Alex. (Fig. 32, B).
1915. *Tipula georgiana* Alexander; Insec. Inscit. Menst., 3:133-134.

Fig.—Alexander, Cfls. N. Y., 1, pl. 52, fig. 311 (hyp.); 1919.

Nasus reduced. General coloration yellow; praescutal stripes poorly defined; a median darker vitta. Antennal flagellum weakly bicolorous to uniformly dark brown. Obliterative area at cord inconspicuous. Male hypopygium with tergite (Fig. 32, B). ♂. L.

11.8-14 mm.; w. 11.5-15.3 mm.; antenna, about 3.5-3.7 mm. ♀. L. 15-16 mm.; w. 14-15 mm.

(Late May-July) Mass., R. I., N. Y., N. J., westw. to Mich., southw. to S. C., Ga., Tenn. and Fla. (Transition, Austral).

Connecticut.—Storrs; Union, July 2, 1919 (S. W. B); Windsor, June 15, 1938 (A. W. M.).

T. (*Lunatipula*) **hirsuta** Doane. (Fig. 32, C).
1901. *Tipula hirsuta* Doane: Journ. N. Y. Ent. Soc., 9: 113-114.

Figs.—Alexander, Cfls. N. Y., 1, pl. 51, fig. 304, pl. 54, fig. 345 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 237, fig. 156 (wing); p. 250, fig. 192 (hyp.); 1932.

Closest to *valida*. Sexes feebly dimorphic in color; male light yellow, female light gray, with darker praescutal stripes. Male hypopygium with the lateral tergal horns (Fig. 32, C) unusually short, the median lobe correspondingly large; inner dististyle greatly expanded. ♂. L. 21-23 mm.; w. 22-24 mm.; antenna, about 6.5-7 mm. ♀. L. 23-25 mm.; w. 24-25 mm.

(Late May, June) Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Mich. and Wisc. (Transition).

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.).

T. (*Lunatipula*) **loewiana** Alex.
1915. *Tipula loewiana* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1915: 488-490.

Figs.—Alexendar, *Ibid*, pl. 16, fig. 12 (wing); pl. 19, fig. 51, pl. 20, fig. 67 (hyp.). Alexander, Cfls. N. Y., 1, pl. 47, fig. 234 (wing); pl. 52, fig. 308 (hyp.); 1919.

Coloration light gray; praescutum with four brown stripes. Abdominal tergites beyond second brown, the lateral margins broadly, the caudal more narrowly, pale. ♂. L. 15 mm.; w. 16-16.5 mm.

Subarctic North America. (Hudsonian).

T. (*Lunatipula*) **mainensis** Alex. (Fig. 32, D).
1915. *Tipula mainensis* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1915: 475-476.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 5 (wing); pl. 18, fig. 31, pl. 19, fig. 46, pl. 21, figs. 75, 76 (hyp.). Alexander, Cfls. N. Y., 1: 850, fig. 125, O (ant.), pl. 48, fig. 253 (wing); pl. 52, fig. 307, pl. 54, fig. 346 (hyp.); 1919.

Mesonotum yellowish, the praescutum with polished dark brown stripes, the median one more or less divided by a pale line. Antennal flagellum bicolorous. Head gray; vertex with a median dark vitta. Abdominal tergites dull yellow, with a median dark stripe; outer segments more uniformly darkened. Male hypopygium with tergite (Fig. 32, D). ♂. L. 10-11 mm.; w. 12 mm.; antenna, about 3.5 mm. ♀. L. 11-12 mm.; w. 12.5-13 mm.

(Late July, Aug.) Ont., Que., Nfd., N. B., Me., N. H., Mass., N. Y., westw. to N. D., Colo. and Alta. (Canadian, Hudsonian).

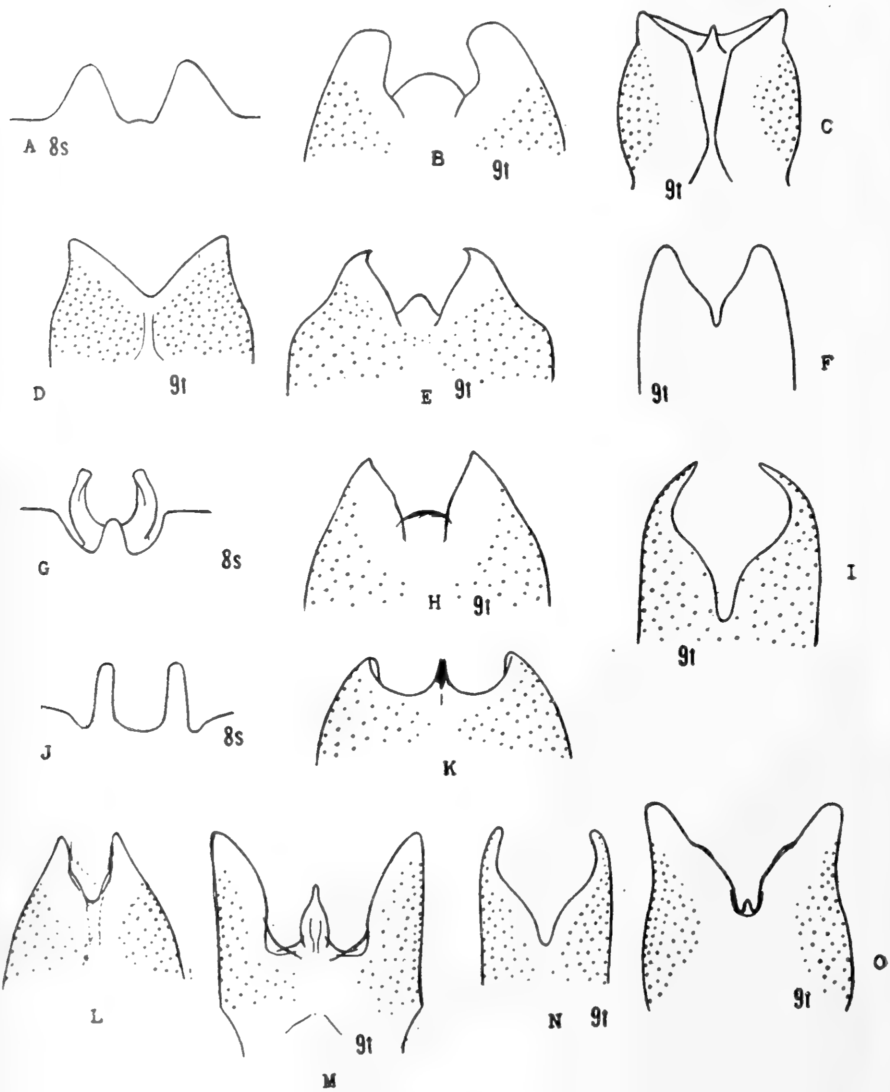


FIGURE 32. *Tipula* (*Lunatipula*); male hypopygia.

A. *T.* (*L.*) *flavoumbrosa* Alex.; 8*s*.
B. *T.* (*L.*) *georgiana* Alex.; 9*t*.
C. *T.* (*L.*) *hirsuta* Lw.; 9*t*.
D. *T.* (*L.*) *mainensis* Alex.; 9*t*.
E. *T.* (*L.*) *monticola* Alex.; 9*t*.
F. *T.* (*L.*) *penicillata* Alex.; 9*t*.
G. *T.* (*L.*) *perlongipes* Johns.; 8*s*.
H. *T.* (*L.*) *seminole* Alex.; 9*t*.
I. *T.* (*L.*) *submaculata* Lw.; 9*t*.
J. *T.* (*L.*) *triplex* Walk.; 8*s*.
K. *T.* (*L.*) *triplex* Walk.; 9*t*.
L. *T.* (*L.*) *translucida* Doane; 9*t*.
M. *T.* (*L.*) *triton* Alex.; 9*t*.
N. *T.* (*L.*) *tuscarora* Alex.; 9*t*.
O. *T.* (*L.*) *valida* Lw.; 9*t*.

Symbols: *s*, sternite; *t*, tergite.

T. (*Lunatipula*) **mallochi** Alex.
1920. *Tipula mallochi* Alexander; Pomona Coll. Journ. Ent. & Zool., 12:91-92.

Differs from *submaculata* chiefly in hypopygial characters. ♂. L. 15 mm.; w. 17-17.5 mm.; antenna, about 5.5-6 mm. ♀. L. 20 mm.; w. 18.5-19 mm.

(May, June) Md., westw. to Ill. and Mo., southw. to S. C., Tenn. and n. Fla. (Transition, Austral).

T. (*Lunatipula*) **monticola** Alex. (Fig. 32, E).
1915. *Tipula monticola* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 492-493.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 14 (wing); pl. 17, fig. 26, pl. 18, fig. 35, pl. 19, fig. 52, pl. 20, fig. 69 (hyp.). Alexander, Cfls. N. Y., 1, pl. 52, fig. 312, pl. 55, fig. 347 (hyp.); 1919.

Flagellum bicolored. Praescutal stripes orange-brown. Male hypopygium with tergite (Fig. 32, E). ♂. L. 17-18 mm.; w. 18-20 mm.; antenna, about 5-6 mm.

(Late May, June) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., Pa.

Connecticut.—Storrs, May 1929 (G. H. G.).

T. (*Lunatipula*) **penicillata** Alex. (Fig. 32, F).
1915. *Tipula penicillata* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 496-497.

Fig.—Alexander, Cfls. N. Y., 1, pl. 52, fig. 314 (hyp.); 1919.

General coloration grayish, the praescutum with four dark brown stripes. Tip of wing darkened; obliterative area at cord broad; post-stigmal brightening in cells R_2 and R_3. Hypopygium with tergite (Fig. 32, F); 8th sternite extensive, with lateral tufts of decussate setae. ♂. L. 12 mm.; w. 12.6 mm.

Subarctic North America. (Hudsonian).

T. (*Lunatipula*) **perlongipes** Johns. (Fig. 32, G).
1848. *Tipula filipes* Walker; List Dipt. Brit. Mus., 1:65 (preoccupied).
1909. *T. perlongipes* Johnson; Proc. Boston Soc. Nat. Hist., 34: 131.

(The confusion resulting from the use of the name *perlongipes* Johnson for an entirely different species in our fauna has been mentioned under *T. jacobus* Alex. The final determination of Walker's species is due to Mr. Fred W. Edwards of the British Museum of Natural History, who examined Walker's type.)

Readily told from other members of the *triplex* subgroup by the relatively narrow yellow wings and the structure of the eighth sternite of the male hypopygium (Fig. 32, G). Stigma paler than costal border. Ground-color of praescutum ranging from pale yellow to gray, the four stripes from light reddish brown to much darker brown. ♂. L. 16-18 mm.; w. 20-22 mm.; antenna, about 6.5-7 mm.

(Apr., May) N. C., westw. to Ind., southw. to Fla. (Austral).

T. (*Lunatipula*) **seminole** Alex. (Fig. 32, H).
1915. *Tipula seminole* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1915: 495-496.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 16 (wing); pl. 17, fig. 28, pl. 18, fig. 37, pl. 19, fig. 54, pl. 21, fig. 77 (hyp.). Alexander, Cfls. N. Y., 1, pl. 55, fig. 348 (hyp.); 1919.

Ninth tergite (Fig. 32, H). Setae of eighth sternite in two flattened, relatively small brushes. ♂. L. 12.5-14 mm.; w. 12.5-14 mm.; antenna, about 4.6-5 mm. ♀. L. 22-23 mm.; w. 15.5-16 mm.

(Apr., May) N. C., Ga.

T. (*Lunatipula*) **submaculata** Lw. (Fig. 32, I).
1863. *Tipula submaculata* Loew; Berlin. Ent. Zeitschr., 7: 288.

Figs.—Alexander, Cfls. N. Y., 1, pl. 47, fig. 239 (wing), pl. 52, fig. 317 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 233, fig. 145 (wing); p. 249, fig. 181 (hyp.); 1932.

Praescutum grayish, with four narrow brown stripes, the intermediate pair more or less obsolete at anterior ends, representing the lateral borders of a broad, more grayish, median area. Heavily-patterned individuals have the outer cells of wing much darker than those before cord. Ninth tergite (Fig. 32, I): there is some variation in length of tergal horns. ♂. L. 12-13 mm.; w. 15-16 mm.; antenna, 5-5.5 mm. ♀. L. 16-19 mm.; w. 15-19 mm.

(May-July) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Mich. and Wisc., southw. to S. C. and Tenn. (Canadian, Transition).

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Tunxis State Park, July 23, 1931 (C. P. A.).

T. (*Lunatipula*) **translucida** Doane. (Fig. 32, L).
1901. *Tipula translucida* Doane; Journ. N. Y. Ent. Soc., 9: 109.
1919. *T. devia* Dietz; Ann. Ent. Soc. Amer., 12: 86-87.

Figs.—Dietz, *Ibid.*, pl. 5, figs. 1, 2 (hyp.). Alexander, Cfls. N. Y., 1, pl. 52, fig. 313 (hyp.); 1919.

Antennae bicolored, yellow, the basal enlargements of segments more or less darkened. Male hypopygium with tergite (Fig. 32, L). ♂. L. 14-16 mm.; w. 16-18 mm.; antenna, about 5 mm.

(June, July) Pa., Md., westw. to Ill., Mo. and Okla., southw. to N. C., S. C. and Tenn. (Austral).

I can see no differences between *devia* and *translucida* except the slightly more acute apex of basistyle of the former.

T. (*Lunatipula*) **triplex** Wk. (Figs. 32, J, K).
1848. *Tipula triplex* Walker; List Dipt. Brit. Mus., 1: 66; Alexander, Bull. Brooklyn Ent. Soc., 25: 277.
1901. *T. inermis* Doane; Jour. N. Y. Ent. Soc., 9: 112.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 14, figs. 89-93 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 47, fig. 236 (wing), pl. 52, fig. 309 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 250, fig. 190 (hyp.); 1932.

General coloration obscure yellow, praescutal stripes brown or grayish brown. Antennae obscure yellow or brownish yellow, weakly bicolorous. Male hypopygium with median tergal spines (Fig. 32, K) long and slender, needle-like. Posterior lobe of inner dististyle long and slender, almost touching the posterior basal appendage. Rods of eighth sternite (Fig. 32, J) slender, parallel-sided, separated by a wide U-shaped notch.

The more southern *umbrosa* Lw. has the median tergal spines shorter and broader, not needle-like; posterior lobe of inner dististyle relatively short and blunt. The exact limits of distribution of the two species have not been accurately determined. ♂. L. 18-20 mm.; w. 20-22 mm.; antenna, 7-7.5 mm. ♀. L. 26-28 mm.; w. 20-23 mm.

(June-Sept.) Ont., Que., Nfd., N. S., Me., N. H., Vt., Mass., R. I., westw. to Wisc. and Alta., southw. to Md. and Va. (Canadian, Transition).

Connecticut.—Norfolk, Sept. 6, 1928 (G. C. C.); South Britain, 1884 (Pierce).

T. (*Lunatipula*) **triton** Alex. (Fig. 32, M).
1915. *Tipula triton* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 487-488.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 11 (wing); pl. 19, fig. 50, pl. 20, figs. 65, 66, pl. 21, figs. 78, 79 (hyp.). Alexander, Cfls. N. Y., 1, pl. 47, fig. 240 (wing); pl. 52, fig. 315 (hyp.); 1919.

Coloration yellow, praescutal stripes light brown to reddish brown. Antennae bicolorous. Abdominal tergites three to six each with a brown lateral spot near base. Ninth tergite (Fig. 32, M). ♂. L. 13-13.5 mm.; w. 13.5 mm.; antenna, about 4.5 mm.

(May) D. C.. Ind., Ky., S. C., Ga. (Austral).

T. (*Lunatipula*) **tuscarora** Alex. (Fig. 32, N).
1915. *Tipula tuscarora* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1915: 493-495.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 15 (wing); pl. 17, fig. 27, pl. 18, fig. 36, pl. 19, fig. 53, pl. 20, fig. 64, pl. 21, fig. 80 (hyp.). Alexander Cfls. N. Y., 1, pl. 47, fig. 241 (wing); pl. 52. fig. 316, pl. 53, fig. 328, pl. 55, fig. 349 (hyp.); 1919.

Coloration yellow, praescutal stripes not or scarcely indicated. Antennae bicolored. Ninth tergite (Fig. 32, N) somewhat as in *submaculata* but horns more obtuse at tips. Readily told from all other nearctic *Tipula* species by the structure of the outer dististyle. ♂. L. 15-16 mm.; w. 17 mm.; antenna, about 4-4.2 mm.

(June) Md., Va. and Ky., westw. to Ind., Ill. and Mo., southw. to N. C. and S. C. (Austral).

T. (*Lunatipula*) **valida** Lw. (Fig. 32, O).
1863. *Tipula valida* Loew; Berlin. Ent. Zeitschr., 7: 287.
1901. *T. calva* Doane; Journ. N. Y. Ent. Soc., 9: 114.

Figs.—Alexander, Cfls. N. Y., 1, pl. 47, fig. 237 (wing); pl. 51, fig. 303 (hyp.); 1919. Dickinson, Cfls. Wisc., p. 237, fig. 155 (wing); p. 250, fig. 191 (hyp.); 1932.

Sexes feebly dimorphic in color; males with praescutum yellow, with four entire more brownish stripes; female yellowish gray, with

darker stripes. Antennae bicolorous. Male hypopygium very large; tergite (Fig. 32, O). ♂. L. 20-22 mm.; w. 20-24 mm.; antenna, 7.5-8 mm. ♀. L. 20-22 mm.; w. 22-24 mm.

(Late May-Aug.) Ont., Que., Nfd., N. B., N. S., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc. and Minn., southw. to N. C. (Canadian, Transition).

Connecticut.—Putnam, June 15, 1933 (C. P. A.); Short Beach (C. W. J.); Windsor, June 13, 1927 (R. B. F.).

Subfamily Cylindrotominae

An isolated subfamily, serving in a remarkable manner to connect the Tipulinae with the Limoniini. The subfamily is of small extent, with only nine genera and about 40 recent species. The distribution is chiefly Holarctic and Antipodal.

The adult flies are sluggish, usually to be swept from rank vegetation in shaded spots. The larvae differ from those of all other crane-flies in their habit of living on the leaves of various bryophytic and spermatophytic plants, where they feed almost in the manner of certain lepidopterous caterpillars. The body of the adult fly, especially the abdomen, is elongate. The ovipositor has fleshy valves of a peculiar structure, modified for the purpose of laying eggs in plant tissues.

Key to Genera

1. Head and mesonotum, excepting the praescutal stripes and centers of scutal lobes, with numerous deep punctures; a deep median longitudinal groove on praescutum; wing (Fig. 33, I) .... **Triogma**
   Head and mesonotum smooth; no median praescutal groove 2
2. Three branches of Radius reach the wing-margin, R_{1+2} being preserved as a distinct element (Fig. 33, E) .... **Phalacrocera,** part
   Two branches of Radius reach the margin, R_{1+2} being entirely atrophied, giving the appearance of a long backward fusion of vein R_1 and the anterior branch of *Rs* (Fig. 33, F-I) 3
3. Four branches of Media reach the margin (Fig. 33, G) .... **Cylindrotoma**
   Three branches of Media reach the margin 4
4. Wings with crossvein *r-m* usually present; outer end of cell *1st* M_2 almost always closed by a single transverse vein, cell M_1 being present, sessile to short-petiolate; cells *2nd* M_2 and M_3 confluent by atrophy or partial atrophy of distal section of vein M_3; antennae nearly simple, the lower face of individual segments not produced (Fig. 33, A, F) **Phalacrocera,** part
   Wings with crossvein *r-m* usually shortened to quite obliterated by the approximation or fusion of veins R_{4+5} and M_{1+2}; outer end of cell *1st* M_2 closed by two transverse veins, these being *m* and the basal section of M_3; cell M_1 lacking, cells *2nd* M_2 and M_3 distinct; antennae strongly nodulose, especially in male, the individual segments nearly cordate (Fig. 33, C, H) .... **Liogma**

Phalacrocera Schiner

1863. *Phalacrocera* Schiner; Wien. Ent. Monatschr., 7: 224.

A limited group (ten species), distributed throughout the Holarctic Region. The venation of the more generalized species (*neoxena*, *replicata*) is quite as in the genus *Tipula* and serves to interpret the

more reduced venation of the remaining members of the subfamily. In all of these, vein R_{1+2} is completely atrophied and vein R_1 merges gradually into R_2, effecting the illusion of a long backward fusion of the anterior branches of R (Fig. 33, F). The missing branch of M is M_3. The free tip of vein Sc_2 is preserved in all local species but the actual tip of Sc_1 is atrophied. The antennae (Fig. 33, A) are 16-segmented, with a structure and appearance that is much as in *Tipula*, the segments being relatively short, with conspicuous basal verticils.

The adult flies are very sluggish in their habits. The larvae are aquatic or nearly so, living and feeding on submerged mosses and seed plants in bogs or similar places.

Key to Species

1. R_{1+2} entirely preserved (Fig. 33, E) .... **neoxena**
   R_{1+2} atrophied (Fig. 33, F) .... **tipulina**

Phalacrocera neoxena Alex. (Fig. 33, E).

1914. *Phalacrocera neoxena* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1914: 603 - 604.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 10 (wing); 1914. Alexander, Cfls. N. Y., 1, pl. 30, fig. 9 (wing); 1919. Alexander, Gen. Ins., Fasc. 187, pl. 2, fig. 6 (wing); 1927.

General coloration dark brown, heavily pruinose, the three praescutal stripes darker gray. Femoral tips insensibly darkened. Wings very strongly suffused with brown; venation (Fig. 33, E) variable, *r-m* present or lost by fusion of adjoining veins. ♂. L. 11.8 - 12 mm.; w. 10.4 - 11 mm. ♀. L. 11.8 mm.; w. 10.9 - 11.9 mm.

(May, June) Ont., Que., N. Y., Pa., westw. to Mich.

P. tipulina O. S. (Fig. 33, A, F).

1865. *Phalacrocera tipulina* Osten Sacken: Proc. Ent. Soc. Philadelphia, 4: 241.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 11, fig. 2 (wing); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1914, pl. 25, fig. 11 (wing); 1914. Alexander, Cfls. N. Y., 1, pl. 30, fig. 8 (wing), text-fig. 125, J (ant. ♂); 1919. Dickinson, Cfls. Wisc., p. 210, fig. 112 (wing); 1932.

Praescutal stripes not well-defined against the dark ground of the notum. Antennae dark, only the base of scape pale. Femoral tips abruptly blackened. Wings grayish brown, the stigma distinct; venation (Fig. 33, F) variable, in cases the element closing cell *1st* M_2 (i. e., m plus basal section of M_3) lies distad, connecting vein M_2 beyond the fork of M_{1+2}; R_{2+3} angulated and almost invariably spurred at proximal end of stigma. Abdominal tergites brown, broadly margined with brownish black. ♂. L. 11 - 13 mm.; w. 8.5 - 10 mm. ♀. L. 14 - 15 mm.; w. 10 - 11.5 mm.

(Late May-early Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich. and Wisc.; (in sphagnum bogs).

Connecticut.—Manitic Lake, June 8 - 9, 1929 (C. P. A.); Putnam, June 15, 1933 (C. P. A.).

Cylindrotoma Macquart

1834. *Cylindrotoma* Macquart; Suit. á Buffon, 1, Hist., Nat. Ins., Dipt., p. 107.

A small group (ten species), distributed throughout the Holarctic Region. The adult flies have the antennae (Fig. 33, B) with long, nearly cylindrical flagellar segments, much longer in male than in female; in male, segments clothed with a dense erect pubescence, in addition to the verticils.

The adults may be swept from swampy and boggy places in woods. The larvae live on the leaves of many genera of higher plants, both monocotyledons and dicotyledons.

Key to Species

1. Tarsi pale yellow, segments two and three concolorous with the basitarsus. **americana**

Tarsi with basitarsus dark brown, its extreme apex and all of segments two and three abruptly light yellow................................**tarsalis**

Cylindrotoma americana O. S.

1865. *Cylindrotoma americana* Osten Sacken; Proc. Ent. Soc. Philadelphia, 4:236.

Figs.—Johnson, Psyche, 19: 2, fig. 2 (ven.); 1912. Alexander, Cfis. N. Y., 1, pl. 30, fig. 6 (wing); 1919.

Pale yellow, praescutum with three distinct black stripes; centers of scutal lobes blackened; dark brown areas on ventral anepisternum and ventral sternopleurite; more or less distinct paired brown spots on posterior border of mediotergite. Tarsal segments one to three pale yellowish brown, the remaining segments darker brown. Venation variable, especially as to position of *r-m* and *m*, in cases the latter before or beyond the fork of M_{1+2}. Abdominal tergites chiefly yellow medially, darkened laterally. ♂. L. 10-12 mm.; w. 9-10 mm.

(Late June, July) Ont., Que., N. B., Me., N. H., N. Y., Pa., westw. to Mich. (Hudsonian, high Canadian).

C. tarsalis Johns. (Fig. 33, B, G).

1912. *Cylindrotoma tarsalis* Johnson; Psyche, 19:2 (♂).
1912. *C.* *? anomala* Johnson; *Ibid.*, 19:2-3 (♀).

Figs.—Johnson, *Ibid.*, 19: 2, text-figs. 3, 4 (ven.); 1912. Alexander, Cfls. N. Y., 1:850, text-fig. 125, K (ant. ♂), pl. 30, fig. 7 (wing); 1919. Alexander, Gen. Ins., Fasc. 187, pl. 2, fig. 1 (wing); 1927.

Quite as in last, differing in the conspicuous light yellow intermediate tarsal segments, which contrast abruptly with the brownish black basitarsi. The darkened spots on anepisternum and mediotergite are reduced or subobsolete; mark on sternopleurite always distinct. ♂. L. 8-9 mm.; w. 7-9 mm. ♀. L. 8 mm.; w. 9 mm.

(Late June-Sept.) N. B., Vt., Ct., N. Y. (Canadian).

Connecticut.—Norfolk, June 12, 1931 (C. P. A.); Sept. 11, 1928, one dead in spider's web (C. P. A.); Sept. 12, 1928, one male flying (G. C. C.).

Liogma Osten Sacken

1869. *Liogma* Osten Sacken; Mon. Dipt. N. Amer., 4: 298.

A very restricted group (seven species), widespread throughout the Holarctic Region. The polished black coloration of our local species, in conjunction with the strongly nodulose antennae, renders the fly conspicuous and easily recognizable. The adults are common in deep shaded woods. The larvae feed on terrestrial mosses.

Key to Subspecies

1. Mesonotum and pleura chiefly polished black, the dorso-pleural membrane yellow .... **nodicornis nodicornis**
   Posterior sclerites of mesonotum and most of thoracic pleura yellow....... **nodicornis flaveola**

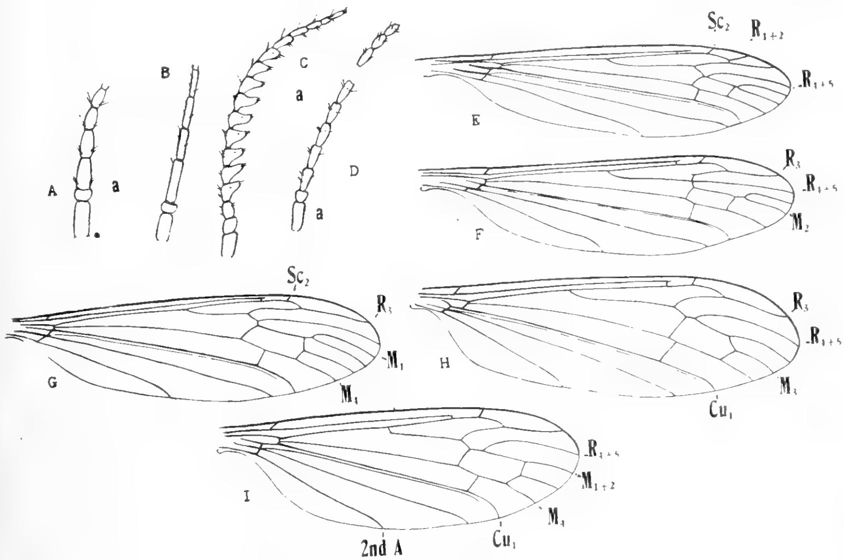


FIGURE 33. Cylindrotominae.

A. *Phalocrocera tipulina* O.S.; antenna, ♂, basal segments.
B. *Cylindrotoma tarsalis* Johns.; the same.
C. *Liogma nodicornis* (O.S.); antenna, ♂.
D. *Triogma exculpta* O.S.; antenna, ♂, base and apex.
E. *Phalacrocera neoxena* Alex.; wing.
F. *P. tipulina* O.S.; wing.
G. *Cylindrotoma tarsalis* Johns.; wing.
H. *Liogma nodicornis* (O.S.); wing.
I. *Triogma exculpta* O.S.; wing.

Symbols: *a*, antenna; *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

Liogma nodicornis nodicornis (O. S.) (Fig. 33, C, H).

1865. *Triogma nodicornis* Osten Sacken; Proc. Ent. Soc. Philadelphia, 4: 239.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 7 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 15, fig. 5 (ven.); 1908. Alexander, Cfls. N. Y., 1: 850, text-fig. 125, I (ant. ♂), pl. 30, fig. 5 (wing); 1919. Alexander, Gen. Ins., Fasc. 187, pl. 1, fig. 1 (entire insect), 6 (ant. ♂); pl. 2, fig. 9 (wing); 1927. Dickinson, Cfls. Wisc., p. 210, fig. 111 (wing); 1932.

Mesonotum and pleura chiefly polished black, the dorso-pleural membrane conspicuously yellow. Venation (Fig. 33, H) with *r-m* sometimes preserved, more often shortened and lost by fusion of adjoining veins. ♂. L. 9 - 12 mm.; w. 8 - 8.5 mm. ♀. L. 10 - 11 mm.; w. 9 - 9.5 mm.

(Late May-early July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ill., Wisc. and Alta.

Connecticut.—Cornwall Bridge, June 13, 1931 (C. P. A.); Granby, June 8, 1929 (C. P. A.); Hamden, June 2, 1928 (R. B. F.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 31, 1931, June 12-13, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 12, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

L. nodicornis flaveola Alex.
1919. *Liogma nodicornis flaveola* Alexander; Can. Ent., 51:195.

Mesonotal praescutum and scutal lobes black; scutellum, mediotergite, except at posterior margin, and pleura, except areas on anepisternum and ventral sternopleurite, light yellow. ♂. L. 11-12 mm.; w. 8.3 - 8.5 mm. ♀. L. 11 mm.; w. 9 mm.

(May-early June) D. C., Va., N. C., Ind., Tenn. (more southern than typical form).

Triogma Schiner

1863. *Triogma* Schiner; Wien. Ent. Monatschr., 7:223.

Only four species are known, almost evenly distributed throughout the Holarctic Region (Europe, Japan, eastern North America). The local species frequents open boggy meadows, where there is little or no shade, the sluggish adults resting on the vegetation. The larvae occur on subaquatic and aquatic mosses in this habitat. The local species is readily told by the small size, uniform brown coloration and entirely opaque, rugulose body.

Triogma exculpta O. S. (Fig. 33, D, I).
1865. *Triogma exculpta* Osten Sacken; Proc. Ent. Soc. Philadelphia, 4:239.

Figs.—Alexander, Gen. Ins., Fasc. 187, pl. 1, fig. 7 (ant. ♂); pl. 2, fig. 11 (wing); 1927.

General coloration dull brown. Terminal segment of flagellum shorter than the penultimate (Fig. 33, D). Praescutal stripes and centers of scutal lobes impunctate. Degree of fusion of R_{4+5} with M_{1+2} variable (Fig. 33, I), in very rare cases with *r-m* distinct. ♂. L. 8 - 9 mm.; w. 6 - 7.5 mm. ♀. L. 8.5 - 9 mm.; w. 6.5 - 7.5 mm.

(Late Apr.-mid-June) N. H., Mass., Ct., N. J., Pa., westw. to Mich.

Connecticut.—Norfolk, June 9, 1929 (C. P. A.); Stamford, May 15, 1932 (B. T. R. L.).

Subfamily Limoniinae

This vast subfamily includes the majority of all small and medium-sized Tipulidae throughout the World. There are five tribes, four of which are represented in the local fauna.

Key to Tribes

1. Eyes hairy; vein Sc_1 very long, Sc_2 lying basad of origin of *Rs* (Fig. 40, A-J) .... **Pediciini** 342
   Eyes glabrous; vein Sc_1 short or of moderate length, when long (some Eriopterini), Sc_2 lying distad of origin of *Rs*; where Sc_2 lies basad of origin of *Rs* (some Limoniini, Eriopterini), the entire vein *Sc* is shortened. 2
2. Free tip of Sc_2 often present; veins R_4 and R_5 fused to margin, only two branches of *Rs* being present (Fig. 34, A, B); antennae usually with 14 (Limoniaria) or 16 segments.......... **Limoniini**
   Free tip of Sc_2 atrophied; veins R_4 and R_5 separate, the former usually captured by R_{2+3} to form a distinct element R_{2+3+4}; usually with three branches of *Rs* present (exceptions in *Atarba*, *Elephantomyia*, *Teucholabis* and some *Gonomyia*, where R_4 is captured by R_{2+3} (Figs. 44, P; 47, E, F, G)); antennae usually with 16 segments.......... 3
3. Tibial spurs present.......... **Hexatomini** 365
   Tibial spurs lacking .... **Eriopterini** 424

Limoniini

A considerable tribe, including within our limits, representatives of six subtribes, of which the Limoniaria are most common and well-known.

Key to Subtribes and Genera

1. Wings with vein R_2 lacking (Fig. 38, B, D).......... 2
   Wings with vein R_2 present (Fig. 38, C, E-G).......... 3
2. Rostrum short and inconspicuous; Sc_2 far from tip of Sc_1, lying basad of the origin of *Rs*, the latter vein long and straight, running close to R_1 and in direct alignment with R_{2+3}; *r-m* distinct (Fig. 38, D). (Ellipteraria) **Elliptera**, part
   Rostrum of moderate length, about equal to or longer than remainder of head; Sc_2 at tip of Sc_1, both being about opposite the fork of *Rs*, the latter vein short, gently arcuated, not in alignment with R_{2+3}; *r-m* often shortened or obliterated by the approximation of adjoining veins (Fig. 38, B). (Heliaria).......... **Helius**
3. Wings with *m-cu* close to or beyond the fork of *M*; if before the distance not or scarcely exceeding the length of the vein itself (Figs. 34, A, B; 38, C, E, F).......... 4
   Wings with *m-cu* far before level of origin of *Rs* (Fig. 38, G). (Orimargaria) .... **Orimarga: Diotrepha**
4. Wings with vein R_2 lying far distad, beyond level of outer end of cell *1st* M_2; *m-cu* beyond fork of *M*; a conspicuous pale fold in distal end of cell *Cu*, shown in illustration by a dotted line (Fig. 38, F). (Dicranoptycharia) .... **Dicranoptycha**
   Wings with R_2 in almost transverse alignment with *r-m* and the basal half of cell *1st* M_2, at most (some *Limonia*) opposite the outer end of cell *1st* M_2; *m-cu* at or slightly before fork of *M*; no fold in cell *Cu*.......... 5
5. Wings with *Rs* long, straight or slightly convex (Fig. 38, C, E); antennae 16-segmented 6
   Wings with *Rs* shorter, more concave in outline (Fig. 34, A, B); antennae 14-segmented (Limoniaria).......... **Limonia**

6. Anal angle of wing prominent, almost square; *Sc* lying very close to *R*, Sc_2 not evident; *Rs* long, straight or slightly convex, diverging from R_1 at an acute angle, ending approximately between the branches of *Rs* or else in alignment with R_{4+5} (Fig. 38, C). (Antocharia) .... **Antocha**

Anal angle of wing normally rounded; *Sc* distinct from *R*, Sc_2 far from tip of Sc_1, lying basad of origin of *Rs*; *Rs* long, lying very close to R_1 and nearly parallel with it, its distal end in alignment with R_{2+3}; basal section of R_{4+5} short and arcuated, diverging at nearly a right angle from the end of *Rs* (Fig. 19, E). (Ellipteraria) .... **Elliptera,** part

1. Subtribe Limoniaria

Limonia Meigen

1800. *Amphinome* Meigen; Nouv. Class. Mouch., p. 15 (nom. nud.).
1803. *Limonia* Meigen; Illiger's Mag., 2:262.
1818. *Limnobia* Meigen; Syst. Beschr. Zweifl. Ins., 1:116.

As now constituted, the subtribe includes only the genus *Limonia*, with about a score of subgenera that have long been held to represent valid generic groups. The reasons for relegating these familiar names to this lesser ranking have been given by the writer in another paper (Philippine Journ. Sci., 40:239-248; 1929).

Limonia, in this broad sense, will very probably be found to be the largest genus of Tipulidae, even exceeding the vast genus *Tipula*. *Limonia* is found in every region of the World, including the lesser oceanic islands, whereas *Tipula* is lacking or virtually so in certain major land areas, notably Australia and New Zealand.

In so protean a group we encounter a tremendous range in structure, involving almost all parts of the body. Thus we have species with elongate rostra (*Geranomyia*, Fig. 34, C), with others having very reduced mouth parts; other forms with branched antennal segments (*Rhipidia*, males, Fig. 34, F, G) to others that have the usual simple structure of this organ; and forms with supernumerary crossveins in certain cells of the wing (*Discobola*) or lacking such extra elements.

The adult flies are very common and familiar. The larvae live in a great variety of ecological habitats, as marine (some *Dicranomyia*, *Geranomyia*); lithophilous, living in saturated mosses and crusts of liverworts on the faces of shaded cliffs (many *Geranomyia*, some *Dicranomyia*); in decaying wood and beneath bark (*Limonia*, *Discobola*, some *Rhipidia*); in fungi (*Limonia*); and, in fact, in the great majority of ecological niches occupied by members of this family.

Key to Subgenera

1. Wings with *m* and both sections of vein M_3 lacking, cell M_3 thus being entirely obliterated (Fig. 34, B) .... **Limonia: Alexandriaria**

Wings with at least the distal section of M_3 preserved and usually with both sections, together with *m*, cell M_3 thus usually present (Fig. 34, A) 2

2. A supernumerary crossvein in cell *1st A*, connecting the two Anal veins. **Limonia: Discobola**

No supernumerary crossvein in cell *1st A* 3

3. Mouth parts, and especially the labial palpi, lengthened, the rostrum thus formed much longer than remainder of head and usually about as long as the combined head and thorax (Fig. 34, C) .... **Limonia: Geranomyia**
   Mouth parts, with the labial palpi, not notably lengthened, shorter than remainder of head 4
4. Antennae (male) more or less branched (bipectinate, unipectinate, or subpectinate, Fig. 34, F, G); of female simply serrate, sometimes weakly so. **Limonia: Rhipidia**
   Antennae simple in both sexes 5
5. Wings with vein *Sc* short, Sc_1 ending opposite or before origin of *Rs*. **Limonia: Dicranomyia** 310
   Wings with *Sc* long, Sc_1 ending beyond midlength of *Rs* (Fig. 15, A). **Limonia: Limonia**

Subgenus **Limonia** Meigen

Key to Species

1. Wings with numerous macrotrichia in all cells beyond cord .... **fusca**
   Wings without macrotrichia in cells of wing 2
2. Wings unmarked, except for stigma when this is present; size small (w., 6 mm. or less) 3
   Wings patterned (except in *sociabilis*); size large (w., 7 mm. or more, usually over 10 mm.) 4
3. No stigmal spot or brown seams to veins; free tip of Sc_2 lying markedly basad of R_2, the latter thus appearing decurved into R_{2+3}; tarsi brown. **globithorax**
   Stigma evident, brown; paler brown seams along cord and outer end of cell *1st* M_2; free tip of Sc_2 and R_2 in transverse alignment; intermediate tarsal segments on all legs whitish .... **macateei**
4. Wings subhyaline, with abundant brown spots and dots in all cells .... **simulans**
   Wings with clouds larger, confined to vicinity of veins 5
5. R_{1+2} and R_2 subequal in length 6
   R_{1+2} two or more times as long as R_2 13
6. Legs uniformly dark brown .... **rara**
   Legs chiefly yellow, the femora banded with dark brown, in rare cases the legs uniformly pale yellow 7
7. Wings yellow, with three eye-like brown markings, placed at origin and fork of *Rs* and at stigma; femora yellow, the tips narrowly dark brown, in rare cases uniformly pale .... **triocellata**
   Wings without such an ocelliform pattern; legs with one or more dark femoral rings basad of the darkened apex (this subterminal dark ring only feebly indicated in *novae-angliae*) 8
8. Knobs of halteres pale at tips; male hypopygium with dististyles separate almost to base; gonapophyses with apical hair-brushes (Fig. 34, H) 9
   Knobs of halteres uniformly brownish black to black; male hypopygium with dististyles fused on basal half; gonapophyses without setae (except in *hudsonica*) (Fig. 34, L) 10
9. Femora with two brown rings .... **cinctipes**
   Femora with three brown rings .... **immatura**
10. Wings with a large dark spot in cell *R* at mid-distance between the arcular area and the mark at origin of *Rs*; male hypopygium with setae on gonapophyses .... **hudsonica**
   Wings without such a spot, being either immaculate in this field, or else with a series of three or more small dots in cell R; male hypopygium with glabrous gonapophyses (Fig. 34, L) 11
11. Wings with cell *R* unmarked between the arcular and radial darkened areas; subterminal dark femoral band obsolete or barely evident ...... **novae-angliae**
   Wings with small dots in a linear series in cell *R*; subterminal dark femoral band present 12

12. Intermediate praescutal stripes lacking or ill-defined, the laterals enclosing a pale median area; antennae chiefly dark brown; wings narrow, with a clear-cut dark brown pattern, the series of spots in cell *R* small and well-defined; size small (w., ♀, about 9.5 mm.) .... **fallax**
    Intermediate praescutal stripes well-marked, at least on posterior half; basal antennal segments chiefly yellow; wings broader, with the pattern paler brown, more diffuse; spots in cell *R* larger, often poorly delimited, more or less confluent; size larger (w., ♀, about 11 mm.) .... **solitaria**
13. Femora brown, the tips conspicuously yellow; wings with three large circular brown costal areas, located at origin of *Rs*, fork of *Sc* and on R_2 .... **maculicosta**
    Femora yellow, with the apices dark brown (color unknown in *sociabilis*); wing-pattern not as described, if with three costal darkenings (*tristigma*), these small and scarcely evident 14
14. Wings with conspicuous brown clouds and seams 15
    Wings immaculate or nearly so, at most with three or four small brown costal dots 17
15. Large species (w., 15 mm. or more); apex of wing very obtuse; all cells beautifully clouded and marbled medially with gray and brown..... **parietina**
    Smaller flies (w., 12 mm. or less); apex of wing normal; wing-markings beyond cord confined to vicinity of veins or lacking; the most evident darkenings appear as a seam along cord and (in *indigena*) as a broken crossband before cord 16
16. Abdominal tergites blackish, the posterior borders conspicuously pale; no transverse cloud before cord of wing .... **badia**
    Abdominal tergites pale, the posterior borders broadly brownish black; a transverse broken crossband before cord of wing .... **indigena**
17. Wings with three small brown dots along costal border; head entirely dark; antennae pale, darkened towards tips .... **tristigma**
    Wings yellowish, without markings; head yellow, except on front; antennae yellow .... **sociabilis**

Limonia (*Limonia*) **badia** (Walk.)

1848. *Limnobia badia* Walker: List Dipt. Brit. Mus., 1:46 (The *badia* of authors previous to 1930 equals *L.* (*Dicranomyia*) *humidicola* (O. S.)).

Head black, pruinose; palpi and antennae black. Mesonotum opaque; praescutum with an indefinite median brown stripe; lateral stripes represented by small brown spots on margin before suture. Halteres pale. Wings with venation much as in *indigena; Rs* longer, spurred at origin; Sc_1 ending just before midlength of *Rs*. ♀. W. 9 mm.

N. S.; probably westw.

I am indebted to Dr. Fred W. Edwards for a re-description of the unique type in the British Museum.

L. (*Limonia*) **cinctipes** (Say) (Fig. 34, A, H).

1823. *Limnobia cinctipes* Say: Journ. Acad. Nat. Sci. Philadelphia, 3:21.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 30, fig. 3 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 32, fig. 29 (wing); 1919. Dickinson, Cfls. Wisc., p. 186, fig. 62 (wing); 1932.

Mesonotum obscure yellow, the praescutum with four narrow dark brown stripes; pleura variegated with brown. Femora with

outer dark ring narrow and subterminal in position, the extreme tip yellow. Wing (Fig. 34, A). Abdomen yellow, narrowly margined laterally with brownish black; a more or less distinct brown crossband just beyond midlength of each segment; hypopygium pale. Male hypopygium (Fig. 34, H) with dististyles distinct; gonapophyses with a brush of setae at inner apical angle. ♂. L. 10 - 16 mm.; w. 13 - 18 mm. Like many other species in the subgenus, the present species shows great variation in size.

(Apr.-June; Aug., Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Man., Mich., Ill., Wisc., Minn., Mo. and Alta., southw. to N. C., S. C., Fla. and Miss.

L. (*Limonia*) **fallax** (Johns.)
1909. *Limnobia fallax* Johnson: Proc. Boston Soc. Nat. Hist., 34: 125.

Fig.—Alexander, Cfls. N. Y., 1, pl. 32, fig. 32 (wing); 1919.

Pronotum and mesonotum narrowly pale medially, with a submedian brown vitta on either side, the dark stripes gradually diverging behind, leaving the scutellum and mediotergite chiefly pale; pleura yellow. The number of brown dots in cell *R* ranges from three to about twelve. ♂. L. about 7 - 7.5 mm.; w. 8 - 8.5 mm. ♀. L. 8 - 9 mm.; w. 9 - 10 mm.

(May-July) N. Y., N. J., Pa., Va., westw. to Ill., Mich., Mo. and Okla., southw. to Tenn. and N. C.

L. (*Limonia*) **fusca** Meig. (Fig. 34, I).
1804. *Limonia fusca* Meigen; Klass., 1: 54.
1856. *Limnobia turpis* Walker: Ins. Saundersiana, Dipt., 3: 300.
1859. *Dicranomyia pubipennis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 211.
1863. *Limnobia pilipennis* Egger: Verh. zool.. bot. Ges. Wien. 13: 1108.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 2 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 31, fig. 28 (wing); 1919.

General coloration dark brown, including antennae and halteres. Legs brown, the femora more yellowish basally. Wings tinged with brown, stigma darker; Sc_1 ending near two-thirds the length of *Rs*. Sc_2 at its tip. Male hypopygium (Fig. 34, I): dorsal dististyle present; rostral spines two, abnormally three. ♂. L. 5.5 - 6 mm.; w. 6 - 7 mm. ♀. L. 6 - 6.5 mm.; w. 7 - 8 mm.

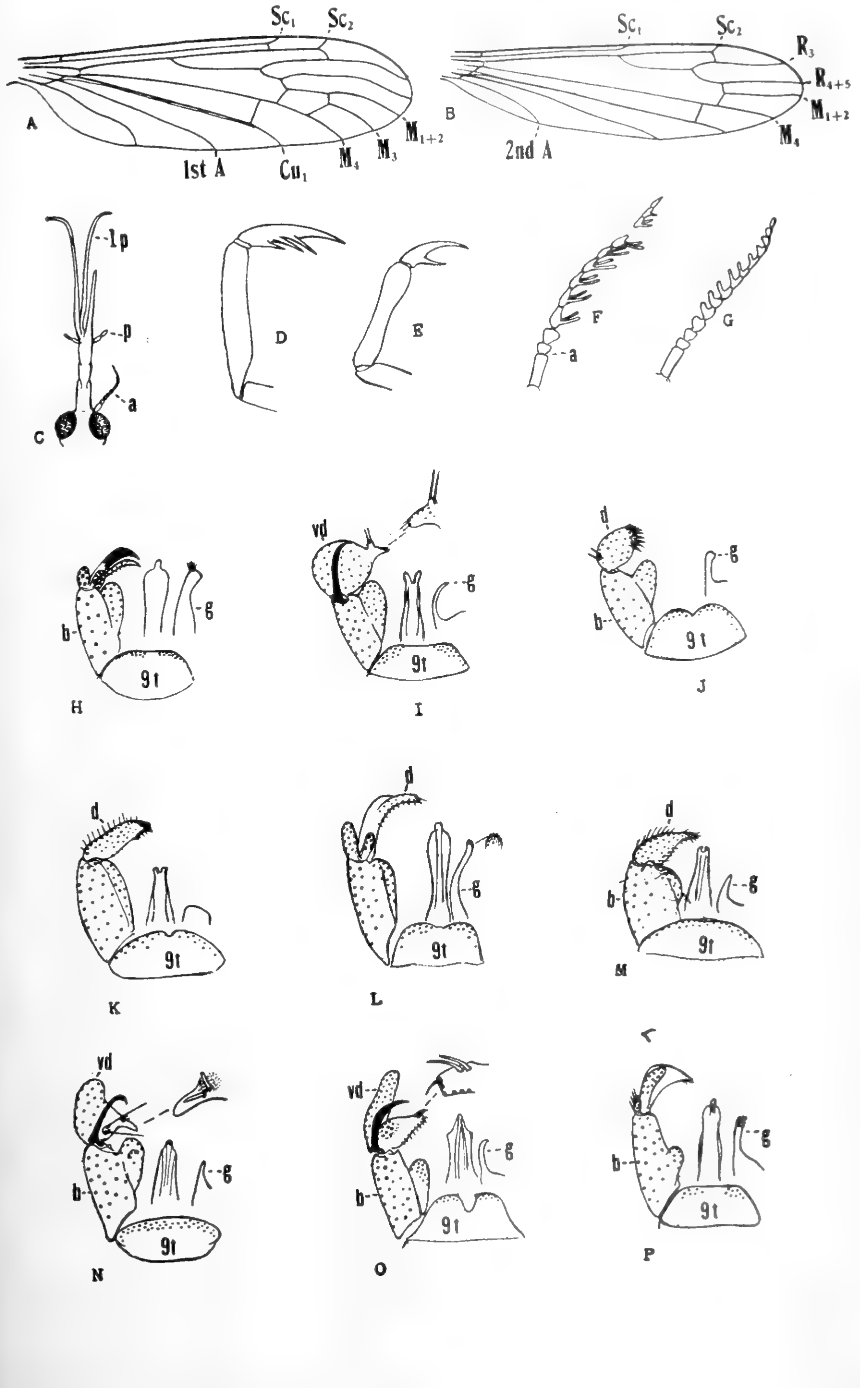
(June-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., southw. to S. C., Ga. and Tenn. (Eurasia). Near streams and in open gorges.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); E. Hartland, Sept. 11, 1928 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 30-31, 1931, July 23-24, 1931 (C. P. A.); Norfolk, May 31, 1931, June 12, 1931, July 24, 1931, Sept. 6, 1928 (C. P. A., G. C. C.); Riverton, May 30, 1931, Sept. 11, 1928 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Union, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); Winsted, June 9, 1929 (C. P. A.), Sept. 5, 1928 (G. C. C.).

FIGURE 34. *Limonia*; details.

A. *Limonia (Limonia) cinctipes* (Say): wing.
B. *L. (Alexandriaria) whartoni* (Ndm.); wing.
C. *L. (Geranomyia) canadensis* (Westw.); head.
D. *L. (Limonia) indigena* (O.S.); claw, ♂.
E. *L. (Dicranomyia) morioides* (O.S.); claw, ♂.
F. *L. (Rhipidia) maculata* (Mg.); antenna, ♂.
G. *L. (R.) fidelis* (O.S.); antenna, ♂.
H. *L. (Limonia) cinctipes* (Say); hyp.
I. *L. (L.) fusca* (Meig.); hyp.
J. *L. (L.) globithorax* (O.S.); hyp.
K. *L. (L.) indigena* (O.S.); hyp.
L. *L. (L.) novae-angliae* Alex.; hyp.
M. *L. (L.) parietina* (O.S.); hyp.
N. *L. (L.) rara* (O.S.); hyp.
O. *L. (L.) simulans* (Walk.); hyp.
P. *L. (L.) triocellata* (O.S.); hyp.

Symbols: *a*, antenna; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *lp*, labial palpus; *p*, maxillary palpus; *t*, tergite; *vd*, ventral dististyle. Venation: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.



A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Sc_1
Sc_2
R_3
R_{4+5}
M_{1+2}
M_3
M_4
Cu_1
1st A
2nd A
lp
p
a
vd
d
b
g
9t

The identity of *turpis* was settled by an examination of Walker's type by Dr. Fred W. Edwards.

L. (*Limonia*) **globithorax** (O. S.) (Fig. 34, J).
1869. *Dicranomyia globithorax* Osten Sacken; Mon. Dipt. N. Amer., 4: 74 - 75.

Figs.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 27 (wing); 1919. Dickinson, Cfls. Wisc., p. 185, fig. 56 (wing); p. 155, fig. 36 (claw); p. 153, fig. 33 (ant.); 1932.

General coloration dark brown. Head, including antennae, more blackened. Halteres dark brown. Praescutum very gibbous. Wings with a strong brown tinge; no stigma; Sc_1 at midlength of Rs, Sc_2 at tip of Sc_1. Male hypopygium (Fig. 34, J): a single fleshy dististyle, set apically with blackened spines. ♂. L. 4 - 5 mm.; w. 4.5 - 6 mm. ♀. L. 5 - 5.5 mm.; w. 5.5 - 6 mm.

(May-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich. and Wisc., southw. to S. C., Tenn. and Fla.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Hartland, Sept. 11, 1928 (C. P. A.); W. Granby, Sept. 4, 1928 (G. C. C.).

L. (*Limonia*) **hudsonica** (O. S.)
1861. *Limnobia hudsonica* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861: 289.

Closely allied to *solitaria*, most readily told by the four major dark areas in cell *R* of wings, the first arcular, third at origin of *Rs*, fourth at fork of *Rs*. Head and pleura heavily pruinose. Male hypopygium with apices of gonapophyses densely hairy. ♂. L. 10 mm.; w. 11 mm. ♀. L. 11 - 12 mm.; w. 11 - 12 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Alta., B. C. and Alaska.

L. (*Limonia*) **immatura** (O. S.)
1859. *Limnobia immatura* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 214.

Fig.—Dickinson, Cfls. Wisc., p. 186, fig. 61 (wing); 1932.

Very similar to *cinctipes*. General coloration of body darker. Femora with last brown ring nearly terminal in position, much narrower than the intermediate band. Stigmal area of wing sometimes almost solidly darkened. ♂. L. 8 - 11 mm.; w. 8.5 - 11.5 mm. ♀. L. 12 - 14 mm.; w. 12 - 13 mm.

(May-early July; Sept.) Ont., Me., N. H., Vt., Mass., N. Y., westw. to Man., Mich., Wisc. and B. C., southw. to N. C., S. C., Tenn. and n. Fla.

Connecticut.—East River, July 19-24, 1912 (Ely); Storrs, 1932 (H. M.).

L. (*Limonia*) **indigena** (O. S.) (Fig. 34, K).
1859. *Limnobia indigena* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 215.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 7 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 32, fig. 33 (wing); 1919. Dickinson, Cfls. Wisc., p. 186, fig. 63 (wing); 1932.

Mesonotum yellow, the praescutum with four dark brown stripes; scutum and scutellum extensively blackened; pleura yellow, with a complete transverse dark brown girdle on anepisternum and sternopleurite. Knobs of halteres pale yellow. Femora with two dark rings, the more basal paler in color. Wing-markings mostly confined to veins, the only areas basad of cord being longitudinal washes in cells *R*, *M*, and a common cloud in *Cu* and *1st A*. Abdominal sternites more uniformly pale than tergites; hypopygium obscure yellow. ♂. L. 8 - 9 mm.; w. 8 - 9 mm. ♀. L. 9 - 12 mm.; w. 9 - 11.5 mm.

(May-Sept.) Ont., Que., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ill., Mich., Wisc. and Ia., southw. to N. C., S. C. and Tenn.

Connecticut.—Hartland, Sept. 11, 1928 (C. P. A.); Kent Falls, May 31, 1931, June 12-13, 1931, July 23-24, 1931 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Rowayton, June 16, 1909 (C. W. J.); Saptree Run State Park, June 14, 1933 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Storrs (C. S. C.).

L. (*Limonia*) **maculicosta** (Coq.)
1905. *Limnobia maculicosta* Coquillett: Journ. N. Y. Ent. Soc., 13: 57.

Mesonotum brown, variegated with yellow. Head and antennae brown. Knobs of halteres yellow. Legs brown, the femoral tips conspicuously yellow. Wings whitish subhyaline, with very distinct seams along cord and dark washes in bases of Anal cells; in cases, a cloud at tip of R_{1+2}. Abdomen brown, bases of individual segments yellow, broader on sternites. ♀. L. 11 - 12 mm.; w. 14 - 15 mm.

(Aug.) Vt., westw. to B. C. and Alaska. (Hudsonian).

L. (*Limonia*) **macateei** (Alex.)
1916. *Dicranomyia macateei* Alexander; Can. Ent., 48: 42-43.
1921. *Dicranomyia varipes* Dietz; Trans. Amer. Ent. Soc., 47: 241-242.

Fig.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 26 (wing); 1919.

General coloration light reddish brown, subnitidous; pleura a trifle paler. Antennae dark throughout. Halteres dark brown. Abdominal tergites dark brown; sternites ringed caudally with yellow. ♂. L. 4 - 4.5 mm.; w. 5 - 5.5 mm. ♀. L. 4.5 - 5.5 mm.; w. 5 - 6 mm.

(June-Oct.) Ont., Me., Vt., Mass., N. Y., Pa., westw. to s. Ind. and Tenn., southw. to w. Fla.

L. (*Limonia*) **novae-angliae** Alex. (Fig. 34, L).
1929. *Limonia* (*Limonia*) *novae-angliae* Alexander: Ent. News, 40: 44-45.

General coloration yellow; praescutum with yellow stripes, the interspaces with narrow black lines. Femora yellow, the tips black,

preceded by a clearer yellow ring; subterminal brown ring lacking or barely indicated. Wings with three major brown areas in cell *R*, with additional paler brown marginal and submarginal clouds; stigma brown, the pale central spot very reduced. In cases, with one or two smaller brown spots in cell *R*, near the arcular darkening. Abdominal tergites brownish yellow, the bases of segments clearer yellow. Male hypopygium (Fig. 34, L): dististyles fused except at tips; gonapophyses slender, tips spiculose, without hair-tufts. ♂. L. 7.5 - 8 mm.; w. 8 - 9 mm. ♀. L. 9.5 - 10 mm.; w. 8.5 - 9 mm.

(Late July-Aug.) Mass., Ct., N. Y.; open gorges, bog margins.

Connecticut.—Manitic Lake, Aug. 6, 1929 (C. P. A.).

L. (*Limonia*) **parietina** (O. S.) (Fig. 34, M).
1861. *Limnobia parietina* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861: 289.

Fig.—Alexander, Cfls. N. Y., 1, pl. 32, fig. 30 (wing); 1919.

Mesonotum yellow pollinose, the praescutum with three brown stripes, the median one sometimes weakly bifid; pleura and sternum extensively blackened. Antennae pale basally, flagellum darker. Male hypopygium (Fig. 34, M) with the dististyle small. ♂. L. 13 - 15 mm.; w. 15 - 19 mm. ♀. L. 16 - 18 mm.; w. 16 - 18 mm.

(Late Aug.-Sept.) Ont., Me., N. H., Vt., Mass., Ct., N. Y., Pa., westw. to Mich. and Ill., southw. to N. C.; near wooded cliffs.

Connecticut.—Hartland, Sept. 11, 1928 (G. C. C.); Norfolk, Sept. 12, 1928 (G. C. C.).

L. (*Limonia*) **rara** (O. S.) (Fig. 34, N).
1869. *Dicranomyia rara* Osten Sacken; Mon. Dipt. N. Amer., 4: 75-76.

Figs.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 25 (wing); 1919. Dickinson, Cfls. Wisc., p. 185, fig. 58 (wing); 1932.

Mesonotum shiny obscure yellow; praescutum with three darker stripes; dorsal pleurites dark brown; sternopleurite more yellow on dorsal portion; scutellum and postnotum black. Front silvery; remainder of head, including antennae, black. Halteres dark brown. Wings brownish, with three darker brown areas, placed at origin *Rs*, fork *Sc*, and at stigma, the latter extensively surrounded by light yellow; narrow brown seams along cord and outer end cell *1st* M_2; *Rs* angulated at origin. Male hypopygium (Fig. 34, N): dorsal dististyle present; ventral dististyle with two pale rostral spines; a small tubercle near base of style, bearing two very long setae; mesal lobe of basistyle bearing an additional small lobule on face. ♂. L. 5.5 - 7 mm.; w. 7 - 9 mm. ♀. L. 6 - 6.5 mm.; w. 7 - 7.5 mm.

(May-July; Aug.-Sept.) N. Y., N. J., Pa., Md., westw. to Ill., Wisc. and Ia., southw. to Ga. and c. Fla.

L. (*Limonia*) **simulans** (Walk.) (Fig. 34, O).
1848. *Limnobia simulans* Walker; List Dipt. Brit Mus., 1:45.
1859. *Dicranomyia defuncta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:213.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 1 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 11, fig. 1 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 31, fig. 24 (wing); 1919.

General coloration gray, the praescutum with three blackish stripes, the median more or less divided by a pale line. Knobs of halteres black. Femora dark brown, tips black, preceded by a conspicuous yellow ring. Wings with four major brown costal areas, in addition to the abundant lesser dotting; Sc_1 ending before midlength *Rs*. Abdomen dark brown; caudal margins of segments, especially of sternites, paler. Male hypopygium (Fig. 34, O): dorsal dististyle present; rostral spines two, pale. ♂. L. 6.5-7 mm.; w. 7.5-8 mm. ♀. L. 8-9 mm.; w. 8-10 mm.

(May-Oct.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., w. to Ill., Mich and Wisc., southw. to S. C. and Tenn.; at margins of fast-flowing streams; on exposed rock surfaces near waterfalls.

Connecticut.—Kent Falls, Sept. 11, 1929 (A. J. W.); May 30-31, June 12, 13, July 23-24, 1931 (C. P. A.); Middletown, June 17, 1909 (C. W. J.); Storrs, May 1929 (C. J. A.); Winsted, June 9, 1929 (C. P. A.).

The identity of *L.* (*L.*) *pellucidiguttata* (Dietz) (Trans. Amer. Ent. Soc., 47:242; 1921) must remain in question and the species may well prove to be distinct. As far as known to me the fly is still represented only by the unique type taken near Hazleton, Pa., July 22, in a swampy area.

L. (*Limonia*) **sociabilis** (O. S.)
1869. *Limnobia sociabilis* Osten Sacken; Mon. Dipt. N. Amer., 4:95-96.

Pronotum and mesonotal praescutum shiny ochre-yellow, with a broad brown median stripe; lateral stripes smaller, more or less coalescent with the median. Head with front and part of vertex brown. Halteres brownish ochreous. Wings yellow, unmarked; R_2 beyond midlength of stigmal area. ♀. L. about 9 mm.

The possibility exists that this is an abnormal form of *tristigma*. As far as known to me, only the unique type, a female, from Illinois, has been discovered.

L. (*Limonia*) **solitaria** (O. S.)
1859. *Limnobia solitaria* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:215.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 6 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 32, fig. 31 (wing); 1919. Dickinson, Cfls. Wisc., p. 155, fig. 37 (claw); p. 153, fig. 34 (ant.); p. 152, fig. 30 (head); p. 186, fig. 60 (wing); p. 247, fig. 160 (hyp.); 1932.

Mesonotum obscure yellow, usually with four brownish black stripes, the intermediate pair sometimes obsolete in front; pleura chiefly pale, with a more or less distinct bloom. Inner brown femoral ring ill-delimited to lacking. Brown spots in cell *R* usually from four to seven, the one beneath origin *Rs* more elongate. Male hypopygium with dististyles fused on basal half; apices of gonapophyses truncated, quite smooth, without setae. ♂. L. 10 - 15 mm.; w. 11 - 16 mm. ♀. L. 11 - 13 mm.; w. 11 - 13 mm.

(May-Sept.) Ont., Que., N. S., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., Minn., Wisc. and Alta.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Kent Falls, May 31, June 12-13, Aug. 19, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Twin Lakes, Sept. 12, 1928 (C. P. A.).

L. (*Limonia*) **triocellata** (O. S.) (Figs. 23, B; 34, P).
1859. *Limnobia triocellata* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 216.

Figs.—Crampton, Journ. Ent. & Zool., 20, fig. 23 (head); 1928. Alexander, Cfls. N. Y., 1, pl. 32, fig. 34 (wing); 1919. Dickinson, Cfls. Wisc., p. 185, fig. 57 (wing); 1932.

Mesonotum polished yellow, the black praescutal stripes broken into spots by having the intermediate portions obsolete; pleura chiefly yellow. Antennae yellow. Knobs of halteres darkened apically. Wings with restricted brown areas, additional to the ocelli, including a seam along cord and marginal clouds at ends of veins. Abdomen yellow; caudal margins of tergites brown; subterminal sternites blackened. Male hypopygium (Fig. 34, P): basistyles elongate, with mesal lobe on cephalic portion; apices of gonapophyses evenly setiferous. ♂. L. 8 - 9 mm.; w. 9 - 11 mm. ♀. L. 8 - 10 mm.; w. 9.5 - 12 mm.

(June-Sept.) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Minn., Wisc., Mich., Man. and Alta., southw. to N. C., S. C., Ga. and Tenn.

Connecticut.—East River, July 28, 1910 (Ely); Riverton, June 12, 1931 (C. P. A.); Salisbury, Sept. 12, 1928 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.); Winnipauk, June 16, 1909 (C. W. J.).

L. (*Limonia*) **tristigma** (O. S.)
1859. *Limnobia tristigma* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 216.

Figs.—Alexander, Cfls. N. Y., 1, pl. 32, fig. 35 (wing); 1919. Dickinson, Cfls. Wisc., p. 187, fig. 64 (wing); 1932.

General coloration yellow; pronotum and praescutum with a brownish black median stripe; lateral stripes less distinct. Knobs of halteres weakly darkened. Legs yellow, femora with apex narrowly dark brown; subterminal ring ill-defined and sometimes obsolete. Wing-spots very small, placed at origin *Rs*, fork *Sc* and at both ends of stigma; R_2 at midlength of stigma. Abdominal tergites light brown; sternites yellow. Male hypopygium with a single dististyle,

much like *parietina;* gonapophyses slender, with pale lateral flange. ♂. L. 8 - 9 mm.; w. 8.5 - 10.5 mm. ♀. L. 9 - 11 mm.; w. 10 - 11 mm.

(July, Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., Wisc. and Alta., southw. to Va., N. C. and Tenn.

On the structure of the male hypopygium, the local species of *Limonia*, s. l., fall in the following groups, based on the progressive specialization of the structure of the dististyle.

1. Dististyle single, entire.—*globithorax, indigena, parietina, tristigma.* (Fig. 34, J, K, M)
2. Dististyle single but more or less split, at least on apical half, forming an incomplete dorsal dististyle.—*cinctipes, fallax, hudsonica, immatura, novae-angliae, solitaria, triocellata.* (Fig. 34, H, L, P)
3. Dististyle so divided that the dorsal dististyle is complete to base, as in the subgenus *Dicranomyia.*—*fusca, rara, simulans.* (Fig. 34, I, N, O)

In the last major paper on the Tipulidae that he wrote, Edwards (Trans. Soc. British Ent., 5:1-168, 31 figs., 5 pls.; 1938) has divided the British species of the subgenus *Limonia* into two subgeneric groups and this division is equally applicable to the species in our local fauna. The restricted subgenus *Limonia* Meigen would include the species in group 1, above (in key, couplets 13-17, including *badia, indigena, maculicosta, parietina, sociabilis* and *tristigma*). For the species of group 2 (in key, couplets 7-12, inclusive), the name *Metalimnobia* Matsumura (1911) is available (including *cinctipes, fallax, hudsonica, immatura, novae-angliae, solitaria* and *triocellata*).

Subgenus **Discobola** O. S.

1865. *Discobola* Osten Sacken; Proc. Ent. Soc. Philadelphia, 4:226.
1869. *Trochobola* Osten Sacken; Mon. Dipt. N. Amer., 4:98.

A widely distributed group, including more than a score of species that show a curious discontinuous distribution, there being about a dozen species in North America and Eurasia, with almost as many more in New Zealand and eastern Australia. The adults of our local species seem especially characteristic of evergreen woods.

Key to Species

1. Knobs of halteres with conspicuous pale apices; wings with a heavy ocellate pattern but without other brown areas in the interspaces .... **annulata**
   Knobs of halteres entirely dark brown; wings with a more delicate ocellate pattern, with additional brown dots in certain cells, especially *M*, where there is a continuous series along vein *Cu* .... **nigroclavata**

Limonia (*Discobola*) **annulata** (Linnaeus) (Fig. 37, A).

1758. *Tipula annulata* Linnaeus; Syst. Nat., Ed. 10:586.
1824. *Limnobia argus* Say; Long's Exped. to St. Peter's R., 2, Appendix :358.
1869. *Trochobola argus* Osten Sacken; Mon. Dipt. N. Amer., 4:98-99.

Figs.—Osten Sacken, *Ibid.*, 4, pl. 1, fig. 4 (wing). Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 28, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 52, fig. 41 (wing); 1919. Dickinson, Cfls. Wisc., p. 187, fig. 65 (wing); 1932.

General coloration polished yellow or greenish yellow, the praescutum with three more or less distinct brown stripes. Antennae black, the apical pedicels of the segments a little paler. Femora with a subterminal black ring, apex clear yellow. Ground-color of wings pale yellow, the pattern pale brown. Male hypopygium (Fig. 37, A). ♂. L. 7.5-8.5 mm.; w. 8-10 mm. ♀. L. 8-9 mm.; w. 9-11 mm.

(June-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., s. to Va. and Tenn., westw. and northwestw. to Neb., Alta. and B. C. (Northern Europe; eastern Asia, s. in mts. to Mindanao and Borneo).

Connecticut.—E. Hartland, Sept. 11, 1928 (C. P. A.); East River, Aug. 29, Sept. 1910 (Ely); Salisbury, Sept. 12, 1928 (C. P. A.); Tunxis State Park, July 23-24, 1931 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

L. (*Discobola*) **nigroclavata** sp. nov.

Generally similar to *annulata* Linn., in the general coloration; subapically banded femora and ocellate wings, differing especially in the more abundant dotted wings and blackish knobs of halteres. Mesonotal praescutum with the three usual brown stripes; lateral margins of praescutum behind the pseudosutural foveae similarly infuscated; scutellum chiefly black, the base medially obscure yellow; mediotergite chiefly darker, with a yellow spot on either side at base. Pleura pale, conspicuously striped longitudinally with brown. Halteres with base of apex of stem pale, the central half of stem and the knobs dark brown. Wings with the ocellate brown pattern paler and more delicate than in *annulata*, with additional small brown spots in cells *M* and in outer radial field. Abdominal tergites brown, the caudal margins of the segments somewhat darker; basal sternites pale. ♀. L. 7-8 mm.; w. 7.5-9 mm.

Holotype. ♀, Tuxedo, N. Y., Aug. 1928 (F. W. Edwards); type in British Museum. *Paratypes*, a broken ♀, Holliston, Mass., Sept. 16, 1929 (B. Gerry), Alexander Collection. ♂. Mount Desert Island, Me., Station F218, September 4, 1936 (Wm. Procter).

The discovery of a second species of *Discobola* in northeastern North America was primarily due to Dr. Edwards' intensive collecting while visiting America in 1928. I express my deep thanks to him for the privilege of describing this fly, as well as for innumerable kindly favors in the past.

Subgenus **Dicranomyia** Steph.

1829. *Dicranomyia* Stephens; Cat. Brit. Ins., 2: 243.

Key to Species

1. Wings unusually narrow, approximately five or more times as long as wide 2
   Wings of normal width, about four times, or a trifle more, as long as wide 4
2. Wings with cell *1st* M_2 open; thoracic pleura with a narrow brown longitudinal stripe; male hypopygium with tergite having a λ-shaped median sclerotized rod; dorsal dististyle present (Fig. 36, B) .... **longipennis**

Wings with cell *1st* M_2 closed; thoracic pleura not striped; male hypopygium having tergite without median sclerotized rod; dorsal dististyle lacking or microscopic 3

3. Male hypopygium with a single spine on rostral prolongation of dististyle, this placed at near midlength of the prolongation (Fig. 35, L) .... **lacroixi**

Male hypopygium with two rostral spines, these placed at about one-third the length of the prolongation (Fig. 36, L) .... **walleyi**

4. Wings with cell *1st* M_2 open by atrophy of *m* 5

Wings with cell *1st* M_2 closed 11

5. Antennae with at least the basal segments pale; body shiny or subnitidous 6

Antennae dark brown throughout; body opaque 7

6. Mesonotal praescutum with a dark median stripe; no brown areas on ventral sternopleurite; male hypopygium with the tergite deeply notched medially; spines of rostral prolongation of moderate length; gonapophyses with a lateral flange (Fig. 35, J) .... **immodesta**

Mesonotal praescutum with three more or less distinct brown stripes; ventral sternopleurites infuscated; male hypopygium with the tergite very shallowly notched medially; rostral spines very long; gonapophyses with mesal-apical lobe slender (Fig. 35, F) .... **gladiator**

7. Wings with Sc_1 ending about opposite origin of *Rs*, the latter fully twice the basal section of R_{4+5}; male hypopygium (Fig. 35, K) .... **iowensis**

Wings with Sc_1 ending some distance before origin of *Rs*, the latter subequal to basal section of R_{4+5}. (*brevivena* and allies) 8

8. Mouth parts relatively long, approximately equal in length to remainder of head .... **rostrifera**

Mouth parts shorter than head 9

9. Rostrum obscure yellow; vein Sc_1 about one-half the length of *m-cu;* male hypopygium (Fig. 35, A) .... **brevivena**

Rostrum dark brown; vein Sc_1 long, subequal to or only a little shorter than *m-cu* 10

10. Praescutum gray pruinose, dark brown medially .... **adirondacensis**

Praescutum with three stripes, the median one subnitidous .... **floridana**

11. Antennae entirely yellow or with basal two segments yellow; body-coloration pale yellow or ochre-yellow; praescutum without distinct stripes 12

Antennae dark, brown or black, throughout; body-coloration yellowish brown, brown, gray or polished black 14

12. Knobs of halteres weakly darkened; male hypopygium with the rostral prolongation bifid at apex; mesal lobe of basistyle complicated by accessory lobules (Fig. 35, D) .... **divisa**

Halteres pale throughout; male hypopygium with the rostral prolongation simple; mesal lobe of basistyle entire 13

13. Male hypopygium with rostral prolongation extended into a long blackened point (Fig. 36, F) .... **pudica**

Male hypopygium with the rostral prolongation short, entirely pale in color (Fig. 36, G) .... **pudicoides**

14. Mesonotum polished black 15

Mesonotum yellowish brown, brown or gray, generally opaque 16

15. Male hypopygium with ventral dististyle small, narrowed gradually into the rostral prolongation, without a deep incision; a single rostral spine (Fig. 36, C) .... **morioides**

Male hypopygium with the ventral dististyle produced into a conspicuous lobe above the base of the prolongation; rostral spine lacking (Fig. 36, D) **nycteris**

16. Femora brown, the tips broadly yellow; male hypopygium (Fig. 35, I).... **humidicola**

Femora without paler tips 17

17. Wings with a heavy brown pattern, distributed as four or five large costal areas, with additional clouds at ends of longitudinal veins .... **decora**

Wings unmarked or nearly so, at most the stigma and apex darkened...... 18

18. Wings with vein Sc_1 long, subequal to or longer than *m-cu* 19

Wings with vein Sc_1 short, approximately one-half to two-thirds *m-cu* or less 26

19. Halteres elongate, approximately one-half length of thorax or more...... 20
Halteres short 22
20. Male hypopygium with a single rostral spine (Fig. 36, I) .... **spinifera**
Male hypopygium with two rostral spines 21
21. General coloration dark brown, more or less pruinose, the praescutal stripes confluent; male hypopygium with the rostral spines at base of prolongation; basistyle with only a simple mesal lobe (Fig. 35, H) .... **halterata**
General coloration yellowish brown, the praescutum with a broad dark brown median stripe; male hypopygium with the subappressed rostral spines placed beyond midlength of prolongation; basistyle with complex mesal outgrowths (Fig. 36, H) .... **sphagnicola**
22. Wings with *Rs* short, subequal to basal section of R_{4+5}; Sc_1 some distance before origin of *Rs* (*brevivena* group) 23
Wings with *Rs* long, approximately twice the basal section of R_{4+5}; Sc_1 ending about opposite origin of *Rs* 24
23. Praescutum with three brown stripes, the median one subnitidous ....**floridana**
Praescutum opaque gray, the median region dark brown ......**adirondacensis**
24. Apical cells of wing strongly infumed, especially in radial field; femora yellow, narrowly tipped with dark brown; male hypopygium (Fig. 36, E) **profunda**
Wings unicolorous, except for the stigma where this is present; femora dark, paler basally 25
25. Wings with stigma lacking or ill-defined; male hypopygium with three to four rostral spines; ventral dististyle and basistyle without supernumerary outgrowths (Fig. 35, C) ....**distans**
Wings with stigma distinct; male hypopygium with two rostral spines; ventral dististyle and basistyle with complex outgrowths (Fig. 35, B)........ **cramptoniana**
26. Sc_1 ending some distance before origin of *Rs*, *Rs* and basal section of R_{4+5} subequal; male hypopygium (Fig. 35, A) ....**brevivena**
Sc_1 ending opposite origin of *Rs* or nearly so; *Rs* conspicuously longer than basal section of R_{4+5} 27
27. General coloration of thorax clear gray 28
General coloration of thorax brown or brownish black, at least on praescutum; pleura not clear gray 29
28. Stigma of wing appearing as a narrow dark seam to vein R_2; male hypopygium with caudal margin of tergite convexly rounded; rostral spines from enlarged basal tubercles (Fig. 36, A) ....**liberta**
Stigma of wing full, oval, of normal shape; male hypopygium with caudal margin of tergite deeply notched; rostral spines not arising from enlarged basal tubercles (Fig. 36, K) ....**uliginosa**
29. Mesonotal praescutum with three confluent dark brown or black stripes; antennae appearing moniliform, the flagellar segments subglobular to short-oval; male hypopygium with dorsal dististyle very slender, strongly arcuated; rostral prolongation beyond the spines slender, blackened (Fig. 36, J) **stulta**
Mesonotal praescutum without such blackened confluent stripes; antennae normal, flagellar segments oval; male hypopygium with the dorsal dististyle broad, only slightly curved; rostral prolongation beyond the spines pale 30
30. Male hypopygium with rostral prolongation stout, the two spines at midlength (Fig. 35, G) ....**haeretica**
Male hypopygium with rostral prolongation long and slender, the two spines near base (Fig. 35, E) ....**gibsoni**

The following doubtful species are omitted from the key:

L. (*Dicranomyia*) **brevivenula** Alex. (Philippine Journ. Sci., 40: 247; 1929; new name for *L.* (*D.*) *flavescens* Dietz, preoccupied; Trans. Amer. Ent. Soc., 47: 239; 1921).

Close to *brevivena*. Thorax dull yellow, with poorly indicated praescutal stripes, the median one divided by a pale line. Rostrum dark yellow. Antennae entirely

dark brown. Head black, grayish silvery behind. Wings yellowish; cell *1st* M_2 closed. Abdomen yellow, the tergites a trifle darker. ♂. L. 3.5 mm.; w. 5.5 mm. Hazleton, Pa., Sept. 24.

By key runs to couplet 11; apparently a distinct species of the *brevivena* complex, distinguished by the yellow body coloration.

L. (*Dicranomyia*) **brunnea** (Doane). (Journ. N. Y. Ent. Soc., 8:184; 1900).

General coloration reddish brown, the praescutum with a capillary paler median line. Antennae brown throughout. Knobs of halteres infuscated. Legs tawny, the tips of femora and tibiae darker. Wings slightly tinged with brown; Sc_1 ending opposite origin of Rs; Sc_1 long. ♀. L. 8 mm.; w. 8 mm. Nantucket Is., Mass.

By key runs to couplet 25; possibly a large *distans*.

L. (*Dicranomyia*) **diversoides** (Dietz). (Trans. Amer. Ent. Soc., 47:240; 1921, as *Dicranomyia*).

Thorax entirely yellow; notum subnitidous; pleura with a slight whitish bloom. Rostrum dark brown. Antennae with outer half of scape and most of pedicel brown, the flagellum more yellowish. Knobs of halteres infuscated. Wings with a faint yellowish tinge; stigma scarcely evident; Sc_1 ending opposite origin of *Rs*, very long, approximately equal to *Rs*, the latter distinctly longer than the basal section of R_{4+5}; cell *1st* M_2 closed. ♀. L. 4.5 mm.; w. 5.3 mm. Hazleton, Pa.; Aug. 4.

By key runs to couplet 11; apparently closest to *divisa* but rostrum dark brown.

L. (*Dicranomyia*) **isabellina** (Doane). (Journ. N. Y. Ent. Soc., 8:183-184; 1900, as *Dicranomyia*).

Thorax ochraceous. Rostrum yellowish; remainder of head yellowish brown. Antennae yellowish, slightly infuscated. Halteres pale, the knobs infuscated. Wings hyaline; stigma faintly indicated; Sc_1 ending a distance before origin of *Rs* about equal to one-half the length of stigma; Sc_1 equal to *Rs*, the latter a trifle longer than basal section of R_{4+5}; cell *1st* M_2 closed. Abdomen brownish yellow, narrowly darker brown laterally. ♀. L. 4 mm.; w. 5.5 mm. Hazleton, Pa., late July, Sept., Oct.

By key runs to couplet 11. The infuscated knobs of halteres agree with *divisa* but not with *pudica*.

L. (*Dicranomyia*) **moniliformis** (Doane). (Doane, *Ibid.*, 8:184; 1900, as *Dicranomyia*).

The holotype was from Colorado and is almost certainly distinct from the paratype, taken on Nantucket Is., Mass. Rogers considers the species as being a synonym of *stulta*; I regard the paratype (but not the type) as probably being identical with *gibsoni*.

L. (*Dicranomyia*) **pennsylvanica** (Dietz). (Trans. Amer. Ent. Soc., 47:239-240; 1921, as *Dicranomyia*).

General coloration reddish yellow; praescutum and pronotum with a well-defined reddish brown median stripe; lateral praescutal stripes less evident, crossing suture onto scutal lobes; pleura pale. Rostrum yellow. Antennae dark brown. Halteres short, knobs dark brown. Legs pale. Wings rather narrow, hyaline, stigma pale; Sc_1 ending just before origin of *Rs*; Sc_1 equal in length to stigma; *Rs* approximately twice the basal section of R_{4+5}; cell *1st* M_2 closed. Abdominal tergites pale brown, the caudal margins indistinctly darkened at posterior ends; sternites pale; hypopygium brownish yellow. ♂. L. 5 mm.; w. 5.5 mm. Hazleton, Pa.; July 20.

By key runs to couplet 25; description agrees fairly well with *sphagnicola*, except for the short halteres and yellow rostrum. Dietz compares this with *brevivenula* (as *flavescens*) but the venational details preclude a close relationship.

Besides the above, the following Western American species have been recorded from Pennsylvania by Dietz (Trans. Amer. Ent. Soc., 47:240-241; 1921): *gracilis* (Doane), type from Idaho; *helva* (Doane), from Colorado; *ochracea* (Doane), from Idaho. These records from the East must be held to be in error.

L. (*Dicranomyia*) **adirondacensis** (Alex.).
1922. *Dicranomyia adirondacensis* Alexander; Bull. Brooklyn Ent. Soc., 17:62.

Close to *brevivena*. General coloration dark brown, gray pruinose. Wings with *Sc* short, Sc_2 far from the tip of Sc_1; *Rs* short, angulated and spurred. Abdomen uniformly dark brown; male hypopygium almost as in *brevivena*. ♂. L. about 4 mm.; w. 4.3-4.5 mm.

(July-Sept.) Que., N. Y., westw. to Wisc., southw. to N. C.

L. (*Dicranomyia*) **brevivena** (O. S.) (Fig. 35, A).
1869. *Dicranomyia brevivena* Osten Sacken; Mon. Dipt. N. Amer., 4:66-67.

Fig.—Dickinson, Cfls. Wisc., p. 182, fig. 51 (wing); 1932.

General coloration dark brown, heavily pruinose. Knobs of halteres darkened. Wings with cell *1st* M_2 closed or open. Abdominal tergites dark brown; sternites yellowish. Male hypopygium (Fig. 35, A). Rostral prolongation with characteristic "goat's-head" appearance; setae at apex of prolongation small; anal tube very long, much exceeding aedeagus. ♂. L. 4-4.5 mm.; w. 4.5-5 mm. ♀. L. 5-5.5 mm.; w. 5.5-6 mm.

(June-Sept.) Ont., Que., Mass., N. Y., Pa., southw. to Fla., westw. to Oregon.

Connecticut.—Hamden, July 10, 1932 (N. T.); Kent Falls, June 12-13, 1931 (C. P. A.).

L. (*Dicranomyia*) **cramptoniana** Alex. (Fig. 35, B).
1926. *Dicranomyia cramptoni* Alexander; Ent. News, 37: 47-49 (preoccupied).
1929. *Limonia* (*Dicranomyia*) *cramptoniana* Alexander; Philippine Journ. Sci., 40:247.

General coloration dark brown; pleura pruinose with yellowish gray. Antennae black throughout. Rostrum dark. Wings tinged with gray. Male hypopygium (Fig. 35, B) large and unusually complicated in structure. ♂. L. 5.5-5.8 mm.; w. 6-6.5 mm. ♀. L. 6.5-7 mm.; w. 6.2-6.4 mm.

(Oct.) Mass.

L. (*Dicranomyia*) **decora** (Staeg.)
1840. *Limnobia decora* Staeger; Kröjer, Naturhist. Tidsskr., 3:47.
1920. *Dicranomyia terrae-novae* Alexander; Pomona Coll. Journ. Ent. and Zool. 12:85-86.

Figs.—Nielsen, Vidensk. Medd. Dansk-naturh. Foren., 74:203 (wing); 1922. Nielsen, Danmarks Fauna. Stankelben, fig. 5 (wing), 6 (hyp.); 1925.

General coloration gray, praescutum with three darker brown stripes. Antennae dark brown. Legs with femora brownish yellow, tips indistinctly darker. Wings whitish subhyaline, with a heavy dark brown pattern, including five major costal areas, the third at origin of *Rs*, the last apical; Sc_2 far from tip Sc_1, located in 2nd dark costal area; *m-cu* about its own length before fork of *M*. Male hypo-

pygium with basistyle black, contrasting with the pale tergite and ventral dististyle; rostral prolongation very small, with two long straight spines. ♂. L. about 5-5.5 mm.; w. 7.5-7.6 mm. ♀. L. about 7-7.5 mm.; w. 7.5-7.7 mm.

(Aug.) Nfld., westw. and northw. to Alta. and Can. Arctic. (Hudsonian). (N. Eurasia).

L. (*Dicranomyia*) **distans** (O. S.) (Fig. 35, C).
1859. *Dicranomyia distans* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 211.

Fig.—Alexander, Cfls. Puerto Rico, pl. 44, fig. 7 (hyp.); 1932.

General coloration dark brown; pleura somewhat paler. Knobs of halteres weakly darkened. Wings with a strong brown tinge. Male hypopygium (Fig. 35, C). ♂. L. 4.5-5 mm.; w. 5.5-6 mm. ♀. L. 5.5-6 mm.; w. 5.5-6 mm.

(Nov.-Feb.) Md., Va., S. C., Ala. and Fla., southw. into Tropical America. Reported from Pa. by Dietz, presumably in error.

L. (*Dicranomyia*) **divisa** Alex. (Fig. 35, D).
1859. *Dicranomyia diversa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 212 (preoccupied).
1929. *Limonia* (*Dicranomyia*) *divisa* Alexander; Philippine Journ. Sci. 40: 247.

Fig.—Alexander, Cfls. Puerto Rico, pl. 44, fig. 8 (hyp.); 1932.

Pale ochreous or brownish yellow; mesonotum unmarked. Rostrum yellow. Antennae with scape and pedicel pale; flagellum dark brown or brownish black. Wings with Sc_1 long. Male hypopygium (Fig. 35, D). ♂. L. 4-4.5 mm.; w. 4.5-5 mm. ♀. L. 5.5-6 mm.; w. 5.5-6 mm.

(May-June; Oct.) Mass., N. Y., Pa., westw. to Mich., Ill., Ia., and Mo.; southw. to Ga. and Fla.; (also in higher mts. of Greater Antilles).

L. (*Dicranomyia*) **floridana** (O. S.)
1869. *Dicranomyia floridana* Osten Sacken; Mon. Dipt. N. Amer., 4: 67.

Closely allied to *brevivena*, differing especially in the brown rostrum and long vein Sc_1; cell *1st* M_2 open or closed. Male hypopygium almost as in *brevivena*.

Md., Va., S. C., Fla. (coastal); having a marine larva.

L. (*Dicranomyia*) **gibsoni** (Alex.) (Fig. 35, E).
1929. *Dicranomyia gibsoni* Alexander; Can. Ent., 61: 17-18.

Allied and generally similar to *haeretica*. General coloration dark brown, thorax with a sparse golden-yellow pollen. Male hypopygium (Fig. 35, E): both this species and *haeretica* have a small setiferous lobule on cephalic mesal angle of ventral dististyle. ♂. L. 7-9 mm.; w. 7-8 mm. ♀. L. about 7 mm.; w. about 8 mm.

FIGURE 35. *Limonia (Dicranomyia)*; male hypopygia.

A. *L. (D.) brevivena* (O.S.)
B. *L. (D.) cramptoniana* (Alex.)
C. *L. (D.) distans* (O.S.)
D. *L. (D.) divisa* Alex.
E. *L. (D.) gibsoni* Alex.
F. *L. (D.) gladiator* (O. S.)
G. *L. (D.) haeretica* (O. S.)
H. *L. (D.) halterata* (O.S.)
I. *L. (D.) humidicola* (O.S.)
J. *L. (D.) immodesta* (O.S.)
K. *L. (D.) iowensis* (Rog.)
L. *L. (D.) lacroixi* (Alex.)

Symbols: *a,* aedeagus; *b,* basistyle; *dd,* dorsal dististyle; *g,* gonapophysis; *t,* tergite; *vd,* ventral dististyle.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(Aug.) Coastal northeastern N. Amer.-N. S., Me., N. H., southw. to Mass., Ct. and N. Y.

Connecticut.—Branford, July 5, 1904 (H. L. V.); Short Beach, July 14, 1904 (P. L. B.); Woodmont, July 9, 1904 (P. L. B.).

L. (*Dicranomyia*) **gladiator** (O. S.) (Fig. 35, F).
1859. *Dicranomyia gladiator* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 212.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 4 (hyp.); 1869. Rogers, Florida Ent., 9: 49, fig. 1 (hyp.); 1926.

General coloration ochraceous yellow. Wings with Sc_1 exceeding *m-cu*. Male hypopygium (Fig. 35, F): outer rostral spine longer and more curved than inner. ♂. L. 5.5-6.5 mm.; w. 6-7 mm. ♀. L. 6.5-7 mm.; w. 6-7 mm.

(Aug.-Oct.) Que., Me., Mass., N. Y., Pa., westw. to Mich. and Alta., southw. to Md., N. C., Tenn. and Ga.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Putnam, July 12, 1905 (H. L. V.).

L. (*Dicranomyia*) **haeretica** (O. S.) (Fig. 35, G).
1869. *Dicranomyia haeretica* Osten Sacken: Mon. Dipt. N. Amer., 4: 70-71.

Figs.—Osten Sacken, *Ibid.*, pl. 1, fig. 3 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 31, fig. 17 (wing); 1919.

General coloration dark brown, with a sparse yellow pollen, median region of praescutum darker. Rostrum brownish yellow to ochreous. Antennae dark throughout. Knobs of halteres darkened. Wings with a faint brownish tinge, stigma scarcely evident; prearcular region whitish. Male hypopygium (Fig. 35, G): ventro-mesal lobe of basistyle of both this species and *gibsoni* very pale and membranous at base, the apex more sclerotized and with abundant setae. Ovipositor with cerci very small and unusually slender; hypovalvae elongate. ♂. L. about 5.5-7 mm.; w. 6.5-8.5 mm. ♀. L. about 6.5-8 mm.; w. 7-9 mm.

(May-Aug.) Ont., N. S., Me., N. H., Vt., Mass., R. I., N. Y., westw. to Mich., Alta. and Alaska; in marshes, coastal and inland.

Connecticut.—East River, July 3, 1911 (Ely); New Haven, June 14, 1915 (M. P. Z.); Orange, July 5, 1911 (S. N. S.); Woodmont, July 9, 1904 (P. L. B.).

L. (*Dicranomyia*) **halterata** (O. S.) (Fig. 35, H).
1869. *Dicranomyia halterata* Osten Sacken; Mon. Dipt. N. Amer., 4: 71-72.

Figs.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 18 (wing); 1919. Dickinson, Cfls. Wisc., p. 182, fig. 53 (erron. ven.); 1932.

Antennae and rostrum dark throughout. Halteres with knobs infuscated. Wings with a brownish tinge, stigma darker; veins coarse. Male hypopygium (Fig. 35, H) brighter than remainder of abdomen; rostral spines at base of long prolongation. ♂. L. 7-8.5 mm.; w. 7.5-9.5 mm.

(June-Aug.) Labr., Que., N. B., N. S., N. H., Vt., Mass., N. Y., and Pa. westw. to Alta., B. C. and Alaska; in bogs.

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.).

L. (*Dicranomyia*) **humidicola** (O. S.) (Fig. 35, I).
1859. *Dicranomyia humidicola* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 210.
(From 1869-1930, erroneously identified as *L.* (*L.*) *badia* (Walk.))

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 2 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 31, fig. 20 (wing); 1919. Dickinson, Cfls. Wisc., p. 182, fig. 52 (wing); 1932.

General coloration dark brown, sparsely variegated with more reddish brown. Rostrum and antennae black. Knobs of halteres dark brown. Wings subhyaline; stigma brown; paler brown clouds in basal cells and along cord; dark pattern of wings sometimes obsolete or nearly so. Abdomen dark brown, the incisures, including the narrow bases and apices of each segment, broadly pale yellow. Male hypopygium (Fig. 35, I): ventral dististyle large and fleshy. ♂. L. 6-8.5 mm.; w. 7.5-9.5 mm. ♀. L. 7.5-8 mm.; w. 8-9 mm.

(May-Nov.) Ont., Que., N. B., Me., Vt., N. Y., Pa., Mo., Okla., westw. to Cal., southw. to S. C. and Tenn. (Southw. into mts. of Cent. Amer.); along rocky streams, in gorges, etc.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 31, June 12-13, July 23-24, 1931 (C. P. A.); Kent Falls, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 6, 11, 1928 (G. C. C.); June 9, 1929 (C. P. A.); Winsted, Sept. 5, 1928 (G. C. C.); May 16, 1931 (C. P. A.). Connecticut, no further data, recorded by Osten Sacken as *badia*.

L. (*Dicranomyia*) **immodesta** (O. S.) (Fig. 35, J).
1859. *Dicranomyia immodesta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 211.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 27, fig. 3 (ven.); 1908. Rogers, Florida Ent., 9: 49, figs. 2, 2a (hyp.); 1926. Dickinson, Cfls. Wisc., p. 181, fig. 50 (wing); 1932.

General coloration yellow. Rostrum yellow. Antennae dark brown, the basal segments paler. Knobs of halteres weakly darkened. Wings with stigma scarcely evident; Sc_1 longer than Rs or *m-cu*. Male hypopygium (Fig. 35, J). ♂. L. 5.5-6.5 mm.; w. 6.5-7.5 mm. ♀. L. about 6-7 mm.; w. 7-8 mm.

(June; Aug.-Oct.) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., Pa., southw. to N. C. and S. C., westw. to Ind., Mich., Minn., Wisc., Ia. and Alta.

Connecticut.—Kent Falls, May 31, 1931 (C. P. A.); Norfolk, Sept. 12, 1928 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Union, Aug. 17-18, 1928 (C. F. C.); W. Granby, Sept. 4, 1928 (G. C. C.), Sept. 11, 1928 (C. P. A.).

L. (*Dicranomyia*) **iowensis** (Rogers) (Fig. 35, K).
1926. *Dicranomyia iowensis* Rogers; Florida Ent., 9: 49-52.

Figs.—Rogers, *Ibid.*, 49: fig. 3 (hyp.), 4 (wing); 1926.

General coloration opaque brown, more or less gray pruinose, pleura sometimes rather heavily so; praescutum darker brown medial-

ly. Rostrum yellow. Wings hyaline, stigma faintly darker. Abdominal tergites brown, sternites more yellow. Male hypopygium (Fig. 35, K). ♂. L. 5-6.5 mm.; w. 5.5-7 mm. ♀. L. 5.5-6.5 mm.; w. 5.5-6.5 mm.

(May-July; Aug.-Oct., probably 2 generations). Que., N. B., Me., N. H., Mass., N. Y., Ind., westw. to Mich. and Ia.

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12, 13, Aug. 19, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

L. (*Dicranomyia*) **lacroixi** (Alex.) (Fig. 35, L).
1926. *Dicranomyia lacroixi* Alexander: Ent. News, 37: 46-47.

General coloration brownish ochreous, the praescutum with three conspicuous dark brown stripes; pleura uniformly ochreous. Antennae black throughout. Wings narrow; axillary region strongly infumed. Male hypopygium (Fig. 35, L). ♂. L. about 6 mm.; w. 6.9 mm.

(July) Mass.; in bogs.

L. (*Dicranomyia*) **liberta** (O. S.) (Fig. 36, A).
1859. *Dicranomyia liberta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 209.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 3 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 31, fig. 21 (wing); 1919. Dickinson, Cfls. Wisc., p. 182, fig. 54 (wing); 1932.

Praescutum with a distinct brown median stripe and narrower, subobsolete lateral stripes. Rostrum and antennae black. Wings subhyaline, cord and outer end of cell *1st* M_2 very narrowly and vaguely seamed with brown; stigma restricted to a narrow seam on R_{1+2} and R_2. Male hypopygium (Fig. 36, A). ♂. L. 5.5-6 mm.; w. 6-7 mm. ♀. L. 6.5-7 mm.; w. 6-7 mm.

(Apr.-June; Aug.-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Man., Ill., Wisc., Ia. and Kan., southw. to S. C., Ga., Fla., Ala. and Miss.

Connecticut.—Canaan, June 10, 1928 (R.B. F.); Farmington, May 16, 1933 (M. P. Z.); Hamden, June 2, 1928 (R. B. F.), Aug. 31, 1932 (N. T.); Kent Falls, June 12-13, 1931, July 23-24, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); New Haven, May 24, 1905 (W. E. B.), May 26, 1904 (H. L. V.), June 20, 1902 (E. J. S. M.); Putnam, July 12, 1905 (H. L. V.); Riverton, June 8, 1929 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C.C.).

L. (*Dicranomyia*) **longipennis** (Schumm.) (Fig. 36, B).
1829. *Limnobia longipennis* Schummel: Beitr. zur Entomol., 1: 104.
1861. *Dicranomyia immemor* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861: 287.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 1 (wing); 1869. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 8, fig. 4 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 31, fig. 14 (wing); 1919. Dickinson, Cfls. Wisc., p. 181, fig. 49 (wing); 1932.

General coloration brownish yellow; praescutal stripes faintly indicated; pleural stripe continued caudad as a narrow, lateral, abdominal line. Rostrum brownish black, somewhat produced. Knobs of halteres weakly darkened. Wings very narrow, yellowish, axillary region darkened. Male hypopygium (Fig. 36, B). ♂. L. 6-7 mm.; w. 7-8 mm. ♀. L. 7-8 mm.; w. 7-8 mm.

(May-Oct.) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., Man., Colo. and Wash. (Eurasia). In marshes.

Connecticut.—East River, July 11, 1910 (Ely); Hamden, July 10, 1932 (N. T.); Kent Falls, May 31, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); W. Granby, June 8, 1929 (G. C. C.).

L. (*Dicranomyia*) **morioides** (O. S.) (Fig. 36, C).
1860. *Dicranomyia morioides* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1860: 17.

Fig.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 23 (wing); 1919.

Pleura silvery, the ventral anepisternum and ventral sternopleurite black. Anterior vertex silvery; remainder of head blackened. Antennae black; terminal segment elongate. Knobs of halteres brownish black. Wings with a brownish tinge, stigma darker; Sc_1 longer than *m-cu*. Abdominal tergites black, sternites pale brown. Male hypopygium (Fig. 36, C). ♂. L. 4-5.5 mm.; w. 4-6.5 mm. ♀. L. 4-5.5 mm.; w. 3.5-5 mm.

(May-Aug.) Ont., Que., N. B., Me., Vt., Mass., N. Y., westw. to Colo., Alta., B. C. and Alaska, southw. to Va., N. C. and Tenn. (Hudsonian, Canadian).

Connecticut.—Kent Falls, May 31, 1931, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.).

L. (*Dicranomyia*) **nycteris** (Alex.) (Fig. 36, D).
1927. *Dicranomyia nycteris* Alexander; Can. Ent., 59: 220.

Allied to the European *morio*; in our fauna most similar to *morioides*. Pleura silvery. Mid-coxae black basally, apical half yellow. Abdominal tergites black, weakly bicolorous; sternites two to five with caudal margins yellow. Male hypopygium (Fig. 36, D). ♂. L. about 3.5-4 mm.; w. 4-5 mm.

(June, early July) Que., N. B., westw. to Mich. and Alta. (Hudsonian).

L. (*Dicranomyia*) **profunda** (Alex.) (Fig. 36, E).
1925. *Dicranomyia profunda* Alex.; Occas. Pap. Boston Soc. Nat. Hist., 5: 173.

General coloration yellow to yellowish brown. Antennae dark throughout. Femora yellow, the tips very narrowly but conspicuously dark brown. Wings yellow; narrow seams at origin of *Rs*, along cord and outer end of cell *1st* M_2. Male hypopygium (Fig. 36, E). ♂. L. 4.5-6 mm.; w. 5-7 mm. ♀. L. 6.5-7.5 mm.; w. 7.2-8.5 mm.

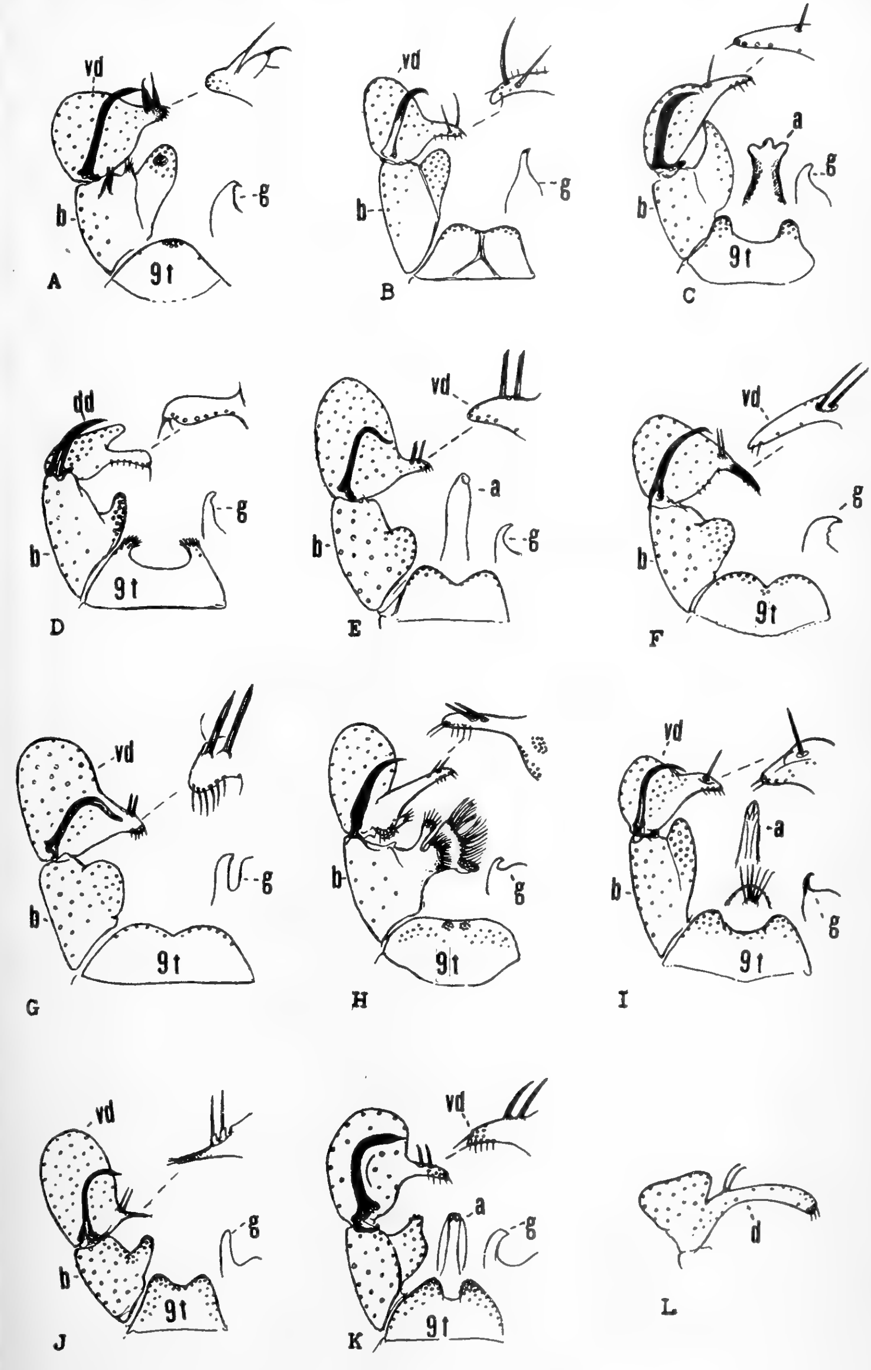
(June-Sept.) Que., N. B., Me., N. H., Vt., Mass., N. Y. (Canadian).

Connecticut.—Tunxis State Park, July 23-24, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

FIGURE 36. *Limonia (Dicranomyia)*; male hypopygia.

A. *L. (D.) liberta* (O.S.)
B. *L. (D.) longipennis* (Schumm.)
C. *L. (D.) morioides* (O.S.)
D. *L. (D.) nycteris* (Alex.)
E. *L. (D.) profunda* (Alex.)
F. *L. (D.) pudica* (O. S.)
G. *L. (D.) pudicoides* Alex.
H. *L. (D.) sphagnicola* (Alex.)
I. *L. (D.) spinifera* (Alex.)
J. *L. (D.) stulta* (O.S.)
K. *L. (D.) uliginosa* Alex.
L. *L. (D.) walleyi* sp. nov.

Symbols: *a,* aedeagus; *b,* basistyle; *dd,* dorsal dististyle; *d,* dististyle; *g,* gonapophysis; *t,* tergite; *vd,* ventral dististyle.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L. (*Dicranomyia*) **pudica** (O. S.) (Fig. 36, F).
1859. *Dicranomyia pudica* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 212.

Fig.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 22 (wing); 1919.

Body almost entirely pale yellow, including antennae, legs and halteres. Wings tinged with pale yellow; stigma lacking or barely perceptible; Sc_1 short, Sc_2 sometimes obsolete. Male hypopygium (Fig. 36, F). Ovipositor with cerci long and slender, gently upcurved. ♂. L. 6-7 mm.; w. 6-7 mm.

(May-July) Que., Me., N. H., Mass., N. Y., Pa., westw. to Mich. and Ill., southw. to N. C.

L. (*Dicranomyia*) **pudicoides** Alex. (Fig. 36, G).
1929. *Limonia* (*Dicranomyia*) *pudicoides* Alexander; Bull. Brooklyn Ent. Soc., 24: 299-300.

Characters as in *pudica*, differing in the structure of the male hypopygium (Fig. 36, G). Antennal scape and pedicel pale but flagellum a trifle darker. Wings with Sc_2 usually lacking. ♂. L. 6-6.5 mm.; w. 6-6.5 mm.

(July-Sept.) N. B., Me., N. Y., westw. to Ind., southw. to Tenn.

L. (*Dicranomyia*) **rostrifera** (O. S.)
1869. *Dicranomyia rostrifera* Osten Sacken: Mon. Dipt. N. Amer., 4: 65-66.

Fig.—Alexander, Cfls. N. Y., 1, pl. 31, fig. 16 (wing); 1919.

General coloration dark gray, notum darker medially. Antennae black throughout. Knobs of halteres dark brown. Wings and hypopygium almost exactly as in *brevivena*. ♂. L. about 4.5 mm.; w. 5-5.5 mm. ♀. L. about 5.5-6 mm.; w. 6-6.5 mm.

(Late Aug., Sept.) Que., Me., N. Y., westw. to Wisc. and Alta. (Hudsonian, Canadian).

L. (*Dicranomyia*) **sphagnicola** (Alex.) (Fig. 36, H).
1925. *Dicranomyia sphagnicola* Alexander: Occas. Pap. Boston Soc. Nat. Hist., 5: 173-174.

General coloration brown. Rostrum and antennae black. Wings with a faint brown tinge; stigma faintly darker; Sc_1 long. Male hypopygium (Fig. 36, H). ♂. L. 4.5-5.5 mm.; w. 5.5-6.5 mm. ♀. L. 5.5-6 mm.; w. 6-6.5 mm.

(June, July; Oct., probably two generations) Ont., Que., N. H., Mass., N. Y., in bogs.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); New Haven, Oct. 16, 1903 (H. L. V.).

L. (*Dicranomyia*) **spinifera** (Alex.) (Fig. 36, I).
1927. *Dicranomyia spinifera* Alexander: Occas. Pap. Boston Soc. Nat. Hist., 5: 229-230.

General coloration of notum opaque brownish yellow, with three confluent dark brown stripes; pleura pruinose; sternopleurite darkened. Abdomen elongate. Male hypopygium (Fig. 36, I): anal tube with a group of about seven long setae. ♂. L. 6-8 mm.; w. 6.5-8 mm. ♀. L. 8-8.5 mm.; w. 8-8.5 mm.

(Late Aug.-Oct.) Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to N. C.

Connecticut.—E. Hartland, Sept. 11, 1928 (G. C. C.); Norfolk, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

Despite its color and elongate halteres, I believe this fly to be most nearly allied to the *morio* group, rather than to *halterata* where it has been placed.

L. (*Dicranomyia*) **stulta** (O. S.) (Fig. 36, J).
1859. *Dicranomyia stulta* Osten Sacken; Proc. Acad. Nat. Sci. Philadalphia, 1859: 210.
1911. *Furcomyia monticola* Alexander; Psyche, 18: 201-202.

Figs.—Alexander, *Ibid.*, 18, pl. 16, fig. 7 (wing), figs. 12, 13 (hyp.); 1911. Alexander, Cfls. N. Y., 1, pl. 31, fig. 19 (wing); 1919. Dickinson, Cfls. Wisc., p. 183, fig. 55 (wing); 1932.

Scutal lobes darkened; pleura yellow. Antennae black. Knobs of halteres infuscated. Wings with Sc_1 ending shortly beyond origin of *Rs*; inner end of cell *1st* M_2 more or less arcuated. Male hypopygium (Fig. 36, J): ventral dististyle large and fleshy. ♂. L. 5.5-6.5 mm.; w. 6-6.5 mm. ♀. L. 6.5-7.5 mm.; w. 6.5-7 mm.

(June-Aug.) Me., N. H., Mass., N. Y., westw. to Ind., Ill., Mich. and Wisc., southw. to S. C., Ga. and Tenn.

Connecticut.—Kent Falls, June 12-13, 1931 (C. P. A.), July 23-24, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Winsted, June 9, 1929 (C. P. A.).

L. (*Dicranomyia*) **uliginosa** Alex. (Fig. 36, K).
1929. *Limonia* (*Dicranomyia*) *uliginosa* Alexander; Bull. Brooklyn Ent. Soc., 24: 27-28.

General coloration gray; praescutum with four narrow brown stripes. Antennae dark throughout. Halteres with brown knobs. Wings with a faint brown tinge; a brown seam along vein *Cu* in cell *M*. Male hypopygium (Fig. 36, K): a small tubercle near apex of mesal lobe of basistyle. ♂. L. 5.5-7 mm.; w. 6.2-8 mm. ♀. L. 7.5 mm.; w. 8 mm.

(June, July) Que., N. H., Vt., N. Y., westw. to Mich., southw. to Tenn. and N. C.

Connecticut.—Manitic Lake, June 8-9, 1929 (C. P. A.).

L. (*Dicranomyia*) **walleyi** sp. nov. (Fig. 36, L).

Wings long and narrow, as in *longipennis*; rostrum and palpi brownish black; general coloration gray, the thoracic pleura indistinctly striped with brown; legs chiefly black; wings whitish subhyaline, the bases of Anal cells and a seam along vein *Cu* brownish;

cell *1st* M_2 closed: male hypopygium with the long rostral prolongation of the ventral dististyle bispinous.

Rostrum and palpi brownish black, the former a little brighter at base in female. Head dark grayish brown, with a sparse yellow pollen.

Mesonotal praescutum gray laterally and on humeral region, more brownish on disk, with a broad brownish black median stripe and narrow, incomplete, lateral stripes; scutal lobes dark brown, the median area with a yellow pollen; scutellum and mediotergite dark, the former with a pale median stripe in front, the latter heavily pruinose. Pleura pale yellowish gray to buffy, striped longitudinally with darker brown, this including the entire ventral sternopleurite and a more dorsal area on anepisternum. Halteres pale, the knobs darkened. Legs very long and conspicuous; coxae and trochanters obscure yellow; remainder of legs dark brown to brownish black, the femoral bases narrowly obscure yellow. Wings long and narrow, whitish subhyaline; bases of cells *Cu*, *1st A* and *2nd A* more infumed, the color continued along vein *Cu* almost to *m-cu*; veins dark, in the prearcular, costal and subcostal fields, as well as basal half of *M*, pale. Venation: *Sc* ending opposite origin of *Rs*; cell *1st* M_2 closed, the veins beyond it tending to diverge.

Abdominal tergites brownish black, narrowly pale sublaterally: a narrow black pleural stripe; sternites obscure yellow, more darkened behind. Male hypopygium (Fig. 36, L) with the dististyle as in *lacroixi*, the body of style larger and more produced; rostral prolongation dusky at apex, before midlength with two strongly curved spines that arise close together. ♂. L. about 6-7 mm.; w. 6.5-8.2 mm. ♀. L. about 8 mm.; w. 8.5 mm.

Holotype, ♂, Mer Bleue, Ontario, September 6, 1928 (G. S. Walley). *Allotopotype*, ♀. *Paratypes*, ♂, Lepreau Harbor, New Brunswick, September 1929 (D. Galbraith); 10 ♂♀, near Chandler, West Pabos R., Gaspé, Quebec, Aug. 25, 1937 (C. P. Alexander); several males and females, Mount Desert Island, Me., September, October (Brower and Procter); for detailed record of specimens, consult William Procter, Biol. Survey Mount Desert Region, Part VI, The Insect Fauna, p. 289; 1938. Type in Canadian National Collection.

Most nearly allied to *lacroixi*, as shown by the key. I dedicate this interesting fly to the collector of the type, my friend, Mr. G. S. Walley. His specimens were found associated with *Phalacrocera tipulina* O. S., *Limonia* (*Dicranomyia*) *longipennis* (Schumm.) and other crane-flies.

Subgenus **Rhipidia** Meigen

1818. *Rhipidia* Meigen; Syst. Beschr. Zweifl. Ins., 1: 153.

An abundant group, wide-spread throughout the major regions of the Globe. In the local fauna, three divisions occur, separated on the nature and degree of pectination of the antennae.

1. *Rhipidia* s. s. (*maculata* group); antennae (♂) bipectinate (Fig. 34, F); *bryanti*, *maculata*.

2. *Monorhipidia* Alexander. (*uniseriata* group): antennae (♂) unipectinate (Fig. 34, G): *fidelis*.
3. *Arhipidia* Alexander. (*domestica* group): antennae of both sexes subpectinate to simple: *domestica*, *shannoni*.

The habits and haunts of the adult flies are much as in *Dicranomyia*. The early stages occur in decaying organic matter or beneath the bark of dead trees.

Key to Species

1. Wings with an abundant pale brown or gray dotting in all cells 2
   Wings with the markings larger, confined to vicinity of veins 3
2. Body-coloration grayish, praescutum with a broad brownish black median line; mediotergite gray; wings with a heavy brown pattern along costal margin, the dark areas subequal in extent to the interspaces; legs brown; antennae (♂) bipectinate .... **maculata**
   Body-coloration yellowish brown, praescutum without a dark median line; mediotergite with a large black triangle; wings with small brownish black spots at base, at supernumerary crossvein in cell *Sc*, origin of *Rs*, fork of *Sc* and over R_2, all these areas much smaller than interspaces; all cells with numerous paler dots; legs chiefly yellow, femoral tips weakly darkened; antennae subpectinate in both sexes .... **shannoni**
3. Praescutum reddish brown, yellow pollinose, with narrow darker lines; pleura dull yellow, with two narrow blackish longitudinal stripes; antennae dark, with penultimate and antepenultimate segments abruptly light yellow; *m-cu* usually far before fork of *M*; antennae subpectinate in both sexes **domestica**
   Praescutum brown, pruinose, with a broad, brownish black, median stripe; pleura grayish or plumbeous, the stripes narrow or lacking; antennae black throughout; *m-cu* at fork of *M*; antennae (♂) unipectinate or bipectinate 4
4. Wings with the dark pattern beyond origin of *Rs* only, including large rounded clouds at origin and fork of *Rs*, stigma, and outer radial cells; costal cell uniformly darkened; thoracic pleura unstriped; abdomen dark brown, hypopygium paler; antennae (♂) unipectinate .... **fidelis**
   Wings with a series of about five major grayish brown areas along costal margin, two being before origin of *Rs*; costal cell not uniformly darkened; thoracic pleura with a narrow longitudinal stripe; abdominal tergites yellow, the caudal half of individual segments dark brown; antennae (♂) bipectinate .... **bryanti**

Limonia (*Rhipidia*) **bryanti** (Johns.) (Fig. 37, B).

1909. *Rhipidia bryanti* Johnson; Proc. Boston Soc. Nat. Hist., 34: 123-124.

Figs.—Johnson, *Ibid.*, pl. 16, fig. 20 (wing); 1909. Alexander, Cfls. N. Y., 1, pl. 32, fig. 37 (wing); 1919. Dickinson, Cfls. Wisc., p. 178, fig. 45 (wing); 1932.

A small blackish spot on either side of cephalic end of praescutum; lateral praescutal stripes subobsolete; pleural stripe very narrow, that on sternopleurite even less distinct. Flagellar branches (♂) relatively short; of ♀ relatively long, unipectinate. Legs black, basal half of fore, basal two-thirds of remaining femora, obscure yellow. Ground color of wing grayish subhyaline, the dark areas narrowly bordered by white, besides the costal areas, with narrower seams along cord and outer end of cell *1st* M_2, and with gray streaks in centers of certain cells. Male hypopygium (Fig. 37, B): rostral spines three, unusually short. ♂. L. 6.5-7 mm.; w. 8-8.5 mm. ♀. L. 9-10 mm.; w. 9-9.5 mm.

(June, July; Sept.) Me., Mass., N. Y., N. J., Md., westw. to Mich., Wisc., Ill., Colo., Tex. and Ariz., southw. to Fla.

L. (*Rhipidia*) **domestica** (O. S.) (Fig. 37, C).
1859. *Rhipidia domestica* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 208.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 5 (hyp.); 1869. Alexander, Bull. Brooklyn Ent. Soc., 8, pl. 1, fig. 9 (wing); 1912. Alexander, Cfls. N. Y., 1, pl. 32, fig. 40 (wing); 1919.

Legs brownish yellow; femora and tibiae darkened at tips. Male hypopygium (Fig. 37, C). The antennal pattern is distinctive of this fly. ♂. L. 5-6 mm.; w. 5-7 mm. ♀. L. 5-6 mm.; w. 6-7 mm.

(July, Aug.) Ct., N. Y., N. J., Pa., westw. to Ia., Kan. and Tex., southw. to S. C., Ga., Fla. and Miss., thence southward into Neotropics.

Connecticut.—East River, Aug. 20, 1912 (Ely).

L. (*Rhipidia*) **fidelis** (O. S.) (Figs. 34, G; 37, D).
1859. *Rhipidia fidelis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 209.

Figs.—Alexander, Cfls. N. Y., 1, text-fig. 125, B (ant. ♂), pl. 32, fig. 38 (wing); 1919.

Praescutum brown to gray, depending on degree of pruinosity. Antennae of male short-unipectinate (Fig. 34, G), of female subpectinate to nearly simple. Halteres pale. Male hypopygium (Fig. 37, D): rostral spines three, long, gently curved. ♂. L. 6-7 mm.; w. 6.5-8 mm. ♀. L. 7-8.5 mm.; w. 7-9 mm.

(May-July) Ont., Que., N. H., Vt., Mass., N. Y., westw. to Ind., Ill. and Alta., southw. to S. C., nw. Fla. and Tenn.

Connecticut.—Rowayton, June 16, 1909 (C. W. J.).

L. (*Rhipidia*) **maculata** (Meig.) (Figs. 34, F; 37, E).
1818. *Rhipidia maculata* Meigen; Syst. Beschr. Zweifl. Ins., 1: 153.

Figs.—Meigen, *Ibid.*, pl. 5, fig. 11. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 27, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1, text-fig. 125, A (ant. ♂), pl. 32, fig. 36 (wing); 1919. Dickinson, Cfls. Wisc., p. 178, fig. 46 (wing); 1932.

Halteres pale. Wing-markings variable in intensity and amount. Male hypopygium (Fig. 37, E): rostral spines usually from four to eight in number. ♂. L. 5-7 mm.; w. 6-7.5 mm. ♀. L. 7-8 mm.; w. 8-9.5 mm.

(June-Sept.) Ont., Que., Me., N. H., Vt., Mass., R. I., N. Y., Pa., westw. to Cal., Alta., B. C. and Alaska, southw. to Va., Ind. and Tenn. (Eurasia).

Connecticut.—East River, July 18, 1912 (Ely); Kent Falls, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 5, 1928 (G. C. C.), Sept. 11, 1928 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Twin Lakes, Sept. 12, 1928 (C. P. A.); Union, Aug. 17-18, 1928 (C. F. C.); W. Granby, Sept. 11, 1928 (C. P. A.); Winsted, Sept. 11, 1928 (C. P. A.).

L. (*Rhipidia*) **shannoni** (Alex.) (Fig. 37, F).
1914. *Rhipidia* (*Arhipidia*) *shannoni* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 581-582.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 23 (wing). Alexander, Cfls. N. Y., 1, pl. 32, fig. 39 (wing); 1919.

Mesonotum yellowish brown; praescutum without distinct stripes, the markings, when present, only near suture; pleura with two narrow longitudinal dark stripes. Sc_1 ending at from one-third to one-fourth the length of *Rs*. Male hypopygium (Fig. 37, F): rostral spines two, slightly unequal. ♂. L. 5 mm.; w. 6.5-6.8 mm. ♀. L. 5.5 mm.; w. 5.8-7.2 mm.

(June-Sept.) Md., Va., s. Ind., Tenn., S. C., Ga. and Fla. (Neotropics).

Subgenus **Alexandriaria** Garrett

1922. *Alexandriaria* Garrett; Proc. Ent. Soc. Washington, 24: 60.

Rather numerous species, occurring in many major regions of the Globe. The single local species is rare and I have seen only the type.

Limonia (*Alexandriaria*) **whartoni** (Ndm.) (Fig. 34, B).
1908. ? *Dicranomyia whartoni* Needham; 23rd Rept. N. Y. St. Ent. for 1907: 211-212.

Figs.—Needham, *Ibid.*, pl. 27, fig. 5 (ven.). Alexander, Cfls. N. Y., 1, pl. 31, fig. 15 (ven.); 1919.

General coloration yellowish; mesonotum darker. Head yellow; antennal flagellum yellowish. Fore legs brownish, middle and hind legs yellow. Wings hyaline; veins brownish. ♀. Expanse of wings 9.5 mm. (each wing thus about 4.2 mm.).

(Aug.) Mich.

Subgenus **Geranomyia** Haliday

1833. *Geranomyia* Haliday; Ent. Mag., 1: 154.

A very extensive group of long-beaked crane-flies, especially numerous in species in the tropics and subtropics. Unlike the other groups of Tipulidae with elongate rostra, this in *Geranomyia* (Fig. 34, C) is constituted almost entirely of greatly lengthened labial palpi, the true front being proportionately short. In all local species, there is a supernumerary crossvein at near midlength of cell *Sc*.

The adult flies are found on vegetation, where they suck nectar from tubular flowers. The immature stages are very characteristic of hygropetric associations, such as the faces of vertical cliffs, rocky margins of streams, and similar situations where the rock surface is covered with algal growth and the surface is continually wet with falling or percolating water.

Key to Species

1. Wings heavily patterned with dark brown, including a series of four or five larger costal areas; tips of tibiae conspicuously blackened, of fore tibiae slightly swollen .... **rostrata**

Wings unmarked, except for stigma, or rarely (*diversa*) with small spots or seams along cord; tips of tibiae neither darkened nor swollen 2

2. *Sc* short, Sc_1 ending opposite or just beyond origin of *Rs*; crossveins and deflections faintly seamed with darker; male hypopygium (Fig. 37, H) with rostral spines from long, unequal basal tubercles .... **diversa**

Sc long, Sc_1 ending opposite or near midlength of *Rs*; wings unmarked, except for the stigmal spot; male hypopygia (Fig. 37, G) with rostral spines from short, inconspicuous tubercles 3

3. Body-coloration reddish yellow, mesonotum unmarked; wings with stigma pale; legs dull yellow, femora not darkened at tips .... **distincta**

Body-coloration yellowish brown, the praescutum and scutum marked with darker; wings with well-defined brown stigma; legs brownish yellow, femora infuscated at tips .... **canadensis**

Limonia (*Geranomyia*) **canadensis** (Westw.) (Figs. 34, C; 37, G).

1835. *Limnobiorhynchus canadensis* Westwood; Ann. Soc. Ent. France, 4:684.

1859. *Geranomyia communis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:207.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 27, fig. 2 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 1 (wing); 1916. Alexander, Cfls. N. Y., 1, text-fig. 124, A (head, ♂); pl. 31, fig. 11 (wing); 1919.

General coloration yellowish brown to grayish brown, the praescutum with three darker brown stripes; posterior sclerites of mesonotum and the pleura more pruinose. Head gray; rostrum and antennae dark. Male hypopygium (Fig. 37, G). ♂. L., exclud. rostrum, 5.5-7 mm.; w. 6.5-8.5 mm.; rostrum, 3.3-3.5 mm. ♀. L., exclud. rostrum, 6.5-7 mm.; w. 7.5-9 mm.; rostrum, 3.5-4 mm.

(May-July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Alta. and Cal., southw. to S. C., Ga., Fla., La., Okla. and Tex.

Connecticut.—East River, July 10, 1910 (Ely); Kent Falls, July 23-24, 1931 (C. P. A.).

L. (*Geranomyia*) **distincta** (Doane).

1900. *Geranomyia distincta* Doane; Journ. N. Y. Ent. Soc., 8:186.

Figs.—Doane, *Ibid.*, pl. 7, fig. 13 (abnormal ven.); 1900. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 2 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 31, fig. 12 (wing); 1919.

Head grayish; rostrum yellowish, browner at base; antennae yellowish brown. Halteres pale. Legs pale yellow. ♂. L., exclud. rostrum, 6.5 mm.; w. 8 mm.

(June) Que., Me., N. H., Mass., Ct., R. I., N. Y., N. J., Md., Ind., Tenn., westw. to Mich., southw. and southwestw. to Fla., Mo. and Tex. (in bogs).

Connecticut.—New Bedford, Hough (Type specimen); Putnam, June 15, 1933 (C. P. A.).

L. (*Geranomyia*) **diversa** (O. S.) (Fig. 37, H).

1859. *Geranomyia diversa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:207.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 4 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 31, fig. 13 (wing); 1919. Cole, Proc. Calif. Acad. Sci., (4) 16:461, fig. 12 (hyp.); 1927.

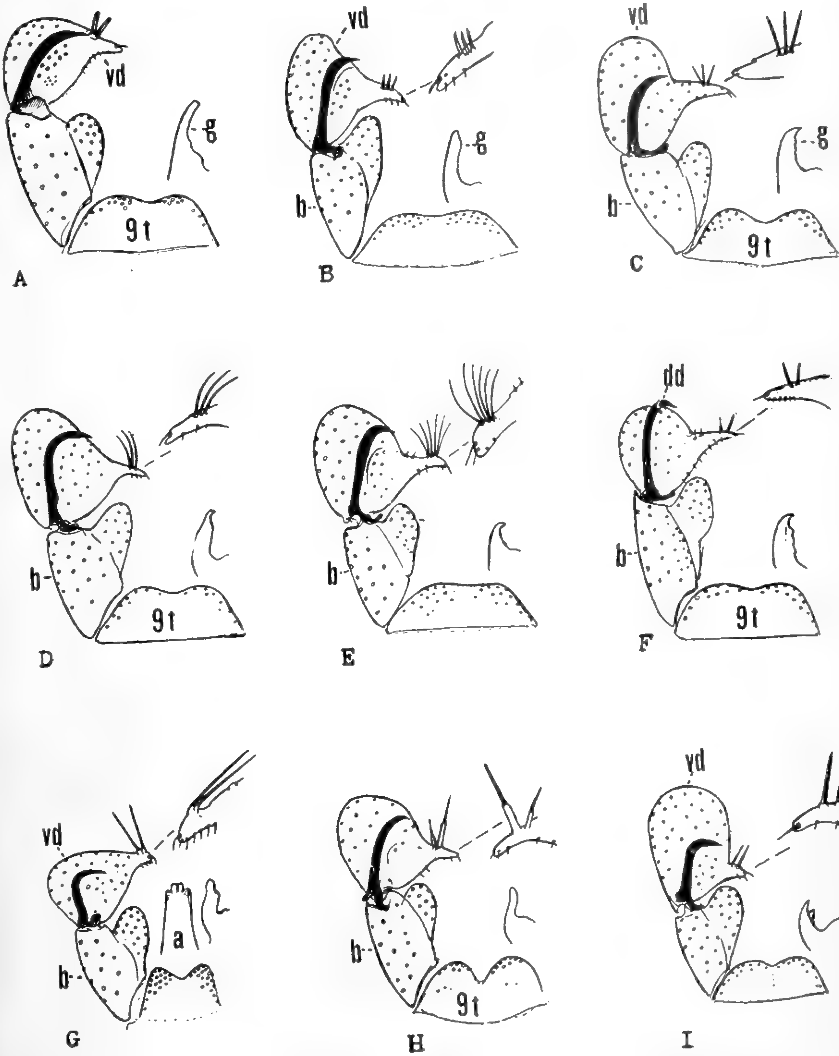


FIGURE 37. *Limonia (Discobola, Rhipidia, Geranomyia)*; male hypopygia.

A. *L.* (*Discobola*) *annulata* (Linnaeus)
B. *L.* (*Rhipidia*) *bryanti* (Johns.)
C. *L.* (*R.*) *domestica* (O. S.)
D. *L.* (*R.*) *fidelis* (O. S.)
E. *L.* (*R.*) *maculata* (Mg.)
F. *L.* (*R.*) *shannoni* (Alex.)
G. *L.* (*Geranomyia*) *canadensis* (Westw.)
H. *L.* (*G.*) *diversa* (O. S.)
I. *L.* (*G.*) *rostrata* (Say)

Symbols: *a*, aedeagus; *b*, basistyle; *dd*, dorsal dististyle; *g*, gonapophysis; *t*, tergite; *vd*, ventral dististyle.

General coloration gray; praescutum with a broad median and narrow lateral blackish stripes. Head gray; posterior vertex with a blackish area on either side; rostrum black. Knobs of halteres darkened. Legs brownish yellow; tarsi darker. Male hypopygium (Fig. 37, H). ♂. L., exclud. rostrum, 5-6.5 mm.; w. 5-6.5 mm.; rostrum 2.2-2.7 mm. ♀. L., exclud. rostrum, 6-7.5 mm.; w. 6.5-7 mm.; rostrum 2.5-2.8 mm.

(May-Oct.) Me., Mass., N. Y., westw. to Ind., Mich., Wisc. and Mo., southw. to N. C., S. C. and Tenn.

Connecticut.—Kent Falls, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.); Middletown, May 30, 1929 (R. C. N.).

L. (*Geranomyia*) **rostrata** (Say). (Fig. 37, I).

1823. *Limnobia rostrata* Say: Journ. Acad. Nat. Sci. Philadelphia, 3: 22.

1869. *Geranomyia rostrata* Osten Sacken; Mon. Dipt. N. Amer., 4: 79-80.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 7 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 31, fig. 10 (wing); 1919.

Mesonotum obscure yellow, the praescutum with three confluent brownish gray stripes; scutal lobes darkened. Knobs of halteres dark brown. Male hypopygium (Fig. 37, I). ♂. L., exclud. rostrum, 5-6.5 mm.; w. 5.5-8 mm.; rostrum, 2.5-3 mm. ♀. L., exclud. rostrum, 5.5-7.5 mm.; w. 5.5-7 mm.; rostrum, 2.6-3.1 mm.

(May-Sept.) Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., Ill. and Mo., southw. to Fla., Ala. and La.

Connecticut.—Hamden, July 11, 1932 (N. T.); Manitic Lake, June 8-9, 1929 (C. P. A.); Rowayton, June 16, 1909 (C. W. J.).

Doubtful species:

L. (*Geranomyia*) **costomaculata** (Dtz.) (Trans. Amer. Ent. Soc., 47: 237-238; 1921, as *Geranomyia*).

Close to *diversa*. Thorax dark brown, pruinose; praescutal stripes obsolete. Wing-spots as in *diversa* but larger and more conspicuous, the first area at supernumerary crossvein in cell *Sc*, the second including both origin of *Rs* and fork of *Sc*; the third, large and rhomboidal in outline, at stigma.

Hazleton, Pa.; May 27, a single ♀.

This fly may represent a valid species by the obsolete praescutal stripes, which are clearly defined in all specimens of *diversa* that I have seen.

2. Subtribe Heliaria

Helius St. Fargeau

1825. *Helius* St. Fargeau; Encycl. Method., Index, p. 831.

1830. *Rhamphidia* Meigen; Syst. Beschr. Zweifl. Ins., 6: 281.

An extensive genus, with representatives in all major regions of the World, including New Zealand. The local species are eminently characteristic of open marshy areas where the adults may be swept from reeds and sedges, while the immature stages live in the black organic soil of the habitat.

Key to Species

1. Rostrum short, subequal to remainder of head; legs pale yellow, with tips of femora and tibiae narrowly blackened; wings tipped with dusky, the stigma dark brown .... **flavipes**
   Rostrum about one-half longer than remainder of head; legs uniformly dark brown; wings subhyaline, the stigma pale brown .... **mainensis**

Helius (*Helius*) **flavipes** (Macq.) (Fig. 38, B).
1855. *Rhamphidia flavipes* Macquart; Dipt. Exot., 5th suppl.: 17.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 14, fig. 4 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916: pl. 25, fig. 13 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 42 (wing); 1919. Dickinson, Cfls. Wisc., p. 188, fig. 66 (wing); 1932.

Mesonotum light to dark brown; pleura more pruinose. Rostrum dark. Wings with *r-m* preserved or lost by fusion of adjoining veins (Fig. 38, B). Abdominal segments dark brown, ringed caudally with obscure yellow. ♂. L. 7-8 mm.; w. 7.5-8 mm. ♀. L. 8-10 mm.; w. 7-8.5 mm.

(May-Sept.) Ont., Que., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Mo., Kan., Man. and Alta., southw. to S. C., Ga., Fla., Ala. and Tex.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); East River, Aug. 29, 1910 (Ely); Kent Falls, Sept. 11, 1929 (A. J. W.); Manitic Lake, June 8-9, 1929, Aug. 6, 1929 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Storrs, May 1933 (R. H.); Tyler Lake, June 13, 1931 (C. P. A.); Union, Aug. 17, 1928 (C. F. C.); Winnipauk, June 16, 1909 (C. W. J.).

H. (*Helius*) **mainensis** (Alex.) (Fig. 38, A).
1916. *Rhamphidia mainensis* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 498-499.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 14 (wing). Alexander, Cfls. N. Y., 1, pl. 33, fig. 43 (wing); 1919. Dickinson, Cfls. Wisc., p. 188, fig. 67 (wing); 1932.

Mesonotum light yellowish brown, the praescutum with three dark brown stripes. Head light gray, with a large brown area on vertical tubercle. Abdomen dark brown, basal sternites and hypopygium yellowish. ♂. L. 6-7.5 mm.; w. 5.8-7.7 mm.

(June-Sept.) Me., N. Y., and Md., westw. to Ill., Mich. and Wisc.

3. Subtribe Antocharia

Antocha Osten Sacken

1859. *Antocha* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 219.

A genus of moderate size (about 35 species in the typical subgenus), most numerously developed in Eastern Asia. The adult flies occur on vegetation or are found crawling on the exposed surfaces of stones, always near streams. The immature stages live on the submerged stones in such locations. The habits have been discussed by the writer (Cornell Univ. Agr. Expt. Sta. Mem. 38: 800-803; 1920). The coloration varies notably and can be relied upon only within re-

stricted limits. The genitalia of the male provide the best characters for specific determination.

Key to Species

(Based especially on male characters)

1. General coloration of mesonotum and pleura gray; male hypopygium with the outer dististyle stout basally, narrowed to a flattened subacute apex. (Fig. 39, C) .... **saxicola**
   General coloration of mesonotum and pleura ochreous; male hypopygium with the outer dististyle not so thickened basally (Fig. 39, A, B) 2
2. Male hypopygium with the outer dististyle elongate, the tip broadly obtuse; gonapophyses small, curved strongly laterad (Fig. 39, A) .... **obtusa**
   Male hypopygium with the outer dististyle narrowed to an acute or subacute point; gonapophyses and other elements of the phallosome long and narrow, nearly straight (Fig. 39, B) .... **opalizans**

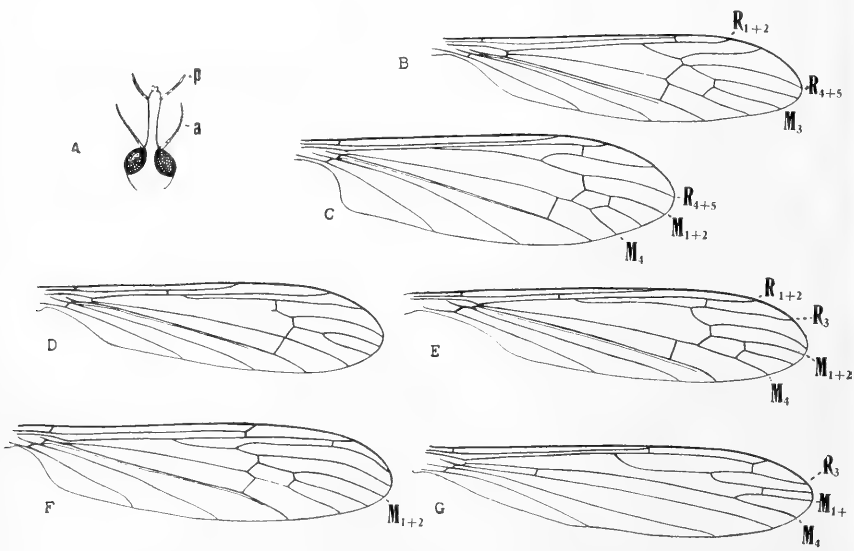


FIGURE 38. Limoniini; details of various subtribes.

A. *Helius (Helius) mainensis* Alex.; head. (Heliaria).
B. *H. (H.) flavipes* (Macq.); wing.
C. *Antocha (Antocha) saxicola* O.S.; wing. (Antocharia).
D. *Elliptera illini* Alex.; wing. (Ellipteraria).
E. *E. tennessa* Alex.; wing.
F. *Dicranoptycha septemtrionis* Alex.; wing. (Dicranoptycharia).
G. *Orimarga (Diotrepha) mirabilis* (O. S.); wing. (Orimargaria).

Symbols: *a*, antenna; *p*, maxillary palpus; *M*, Media; *R*, Radius.

Antocha (*Antocha*) **obtusa** Alex. (Fig. 39, A).

1925. *Antocha* (*Antocha*) *obtusa* Alexander; Ent. News, 36: 201-202.

General coloration ochreous, the praescutum with a conspicuous brown median stripe. Male hypopygium (Fig. 39, A). ♂. L. about 4.8 mm.; w. 5.5 mm. ♀. L. about 5.2 mm.; w. 6 mm.

(May-Aug.) Que., N. Y., Mich.

A. (*Antocha*) **opalizans** O. S. (Fig. 39, B).
1859. *Antocha opalizans* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 220.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 11 (wing); 1869. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 8, figs. 5, 8, 11 (hyp.); 1904. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 29, fig. 4 (ven.); 1908. Dickinson, Cfls Wisc., p. 189, fig. 68 (wing); 1932.

General coloration ochreous; praescutum with a broad median and narrow incomplete lateral brown stripes. Knobs of halteres weakly darkened. Wings opalescent, milky-white, brighter at base. Abdomen dark brown; hypopygium obscure yellow. Male hypopygium (Fig. 39, B). ♂. L. 4-5 mm.; w. 4.5-6 mm. ♀. L. 4.5-6 mm.; w. 5-6 mm.

(May-Sept.) Que., Me., N. H., Vt., Mass., N. Y., westw. to Ill. and Wisc., southw. to N. C., S. C. and Tenn.

Connecticut.—Cornwall Bridge, June 13, 1931 (C. P. A.); Kent Falls, June 12-13, July 23-24, 1931 (C. P. A.); Middletown, May 26, 1929 (R. C. N.); Norfolk, May 31, July 24, 1931 (C. P. A.); Riverton, June 8, 1929, June 12, 1931 (C. P. A.); Union, May 27, 1922 (W. E. B.).

A. (*Antocha*) **saxicola** O. S. (Figs. 38, C; 39, C).
1859. *Antocha saxicola* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 219.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 10 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 33, fig. 48 (ven.); 1919.

General coloration gray or brownish gray to ochreous, the praescutum with clearer brown stripes, the median one bifid at posterior end. Male hypopygium (Fig. 39, C). ♂. L. 4-6 mm.; w. 5-7 mm. ♀. L. 4.5-5.5 mm.; w. 5-6 mm.

(May-Sept.) Que., Ont., N. S., N. H., Vt., Mass., N. Y., Pa., westw. to Mich. and Mo., southw. to Ga.

Connecticut.—Danbury, June 15, 1909 (C. W. J.); Kent Falls, Sept. 11, 1929 (A. J. W.); Riverton, June 12, 1931 (C. P. A.), Salisbury, July 16, 1926 (W. E. B.); Southington, May 28, 1920 (R. B. F.); Winnipauk, June 16, 1909 (C. W. J.).

4. Subtribe Ellipteraria

Elliptera Schin.

1863. *Elliptera* Schiner; Wien. Ent. Monatschr., 7: 222.

A small genus (nine species) of Holarctic crane-flies, occurring discontinuously in the eastern and western Palaearctic and Nearctic regions. The flies favor the vicinity of waterfalls and small streamlets dripping and percolating down the faces of vertical cliffs, the adults resting on the cliff face and on nearby vegetation. The larvae live in the algal growth in this habitat (see Rogers, Occas. Papers Mus. Zool., Univ. Mich., 215: 25-27; 1930). The fly described as *Elliptera alexanderi* Johnson is a *Gonomyia* (*Lipophleps*), q. v.

Key to Species

1. Size small (w., ♂, 7 mm. or less); wings with cell *1st* M_2 open by atrophy of basal section of M_3; R_2 atrophied; basal section R_{4+5} angulated and weakly spurred; *m-cu* at or close to fork of *M* (Fig. 38, D) ....**illini**
   Size larger (w., ♂, over 8 mm.); wings with cell *1st* M_2 normally closed; R_2 present as a weak element about in alignment with *r-m*; basal section R_{4+5} arcuated; *m-cu* some distance before fork of *M* (Fig. 38, E)....**tennessa**

Elliptera illini Alex. (Fig. 38, D).
1920. *Elliptera illini* Alexander: Pomona Journ. Ent. and Zool., 12: 86-87.

General coloration obscure yellow; praescutum with three brown stripes, confluent or nearly so; pleura yellow. Wings with a faint brown tinge (Fig. 38, D). ♂. L. 4.5-5 mm.; w. 6-6.5 mm. ♀. L. about 5 mm.; w. 6 mm.

(June) Tenn., s. Ill.

E. tennessa Alex. (Fig. 38, E).
1926. *Elliptera tennessa* Alexander; Insec. Inscit. Menst., 14: 114-115.

General coloration ochreous yellow; praescutum with three conspicuous, confluent, brown stripes. Wings faintly tinged with brown. ♂. L. about 5.5 mm.; w. 8.3-8.5 mm. ♀. L. about 5.5-6 mm.; w. 7.5-8.5 mm.

(June) Tenn.

5. Subtribe Dicranoptycharia

Dicranoptycha O. S.

1859. *Dicranoptycha* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 217.

A small genus of Holarctic and Ethiopian crane-flies, having several species within our limits. The adults occur in humid to relatively dry open woodlands, in the soil of which the larvae live. The coloration of the scape of the antennae appears to vary within the limits of a single species from yellow to almost black.

Key to Species
(Based in part on male characters)

1. Wings with a strong reddish brown or fulvous tinge; *Rs* conspicuously longer than cell *1st* M_2; male hypopygium (Fig. 39, E) with the lateral tergal arms acute at tips; gonapophyses covered with short points so as to appear mace-like ....**germana**
   Wings not strongly fulvous, tinged with grayish to pale yellow; *Rs* approximately equal in length to cell *1st* M_2 or but slightly longer (*winnemana*); hypopygium not as above 2
2. Fore femora extensively blackened, the bases restrictedly pale; remaining femora more narrowly blackened at tips 3
   Femora at most blackened only at extreme tips; in most species uniformly pale 4
3. Costal fringe of wings (♂) long and conspicuous ....**sobrina**
   Costal fringe of wings (♂) short and dense ....**megaphallus**
4. Tips of femora narrowly blackened or strongly infumed; male hypopygium with outer margin of outer dististyle smooth (Fig. 39, G, K) 5

Femora uniformly pale; male hypopygium with outer margin of outer dististyle roughened (except in *pallida*) 7

5. Tips of femora very narrowly dark brown; abdominal tergites transversely banded, tigrine in appearance, the apical third of each segment being pale; a subterminal dark brown ring (♂); male hypopygium with gonapophyses very long, bifid near tips (Fig. 39, K) .... **tigrina**

Tips of femora more broadly and evidently blackened; abdominal tergites brownish yellow, without subterminal darkening (♂); male hypopygium with the gonapophyses not greatly exserted or bifid at tips 6

6. Size large (L., ♂, about 10 mm.); wings brownish yellow, the costal region more saturated; legs pale, the coloration chiefly concealed by dense black setae .... **nigripes**

Size small (L., ♂, under 8 mm.); wings pale brown; legs pale yellow, the tips of femora and tibiae narrowly blackened .... **minima**

7. Body-coloration very pale, yellow or brownish yellow; wings yellow 8

Body-coloration dark brown or gray; wings grayish to pale brown 9

8. Male hypopygium with outer margin of outer dististyle microscopically roughened into points (Fig. 39, L) .... **winnemana**

Male hypopygium with the outer margin of outer dististyle smooth (Fig. 39, H) .... **pallida**

9. Male hypopygium with aedeagus bifid at apex; lateral arms of tergite expanded and truncate at tips (Fig. 39, D) .... **elsa**

Male hypopygium with aedeagus simple; lateral arms of tergite parallel-sided or gradually narrowed to the obtusely rounded tips. (Fig. 39, I) **septemtrionis**

Dicranoptycha elsa Alex. (Fig. 39, D).
1929. *Dicranoptycha elsa* Alexander; Bull. Brooklyn Ent. Soc., 24: 28-29.

Allied to *septemtrionis* in general coloration and short costal fringe of male. Male hypopygium (Fig. 39, D) with dististyles angularly bent. Aedeagus bifid at apex. ♂. L. about 9 mm.; w. 9 mm. ♀. L. about 10 mm.; w. 9.5 mm.

(Aug.) N. Y., southw. to N. C. (Transition).

D. germana O. S. (Fig. 39, E).
1859. *Dicranoptycha germana* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 217.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 27, fig. 6 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 10 (ven.); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 49 (wing); 1919.

Mesonotum yellowish brown, praescutum darker brown medially; pleura feebly pruinose. Head light gray. Femoral tips very narrowly and vaguely infumed. Costal region of wing more saturated than disk; costal fringe (♂) relatively short, brown; trichia of veins golden-yellow. Abdomen light brown, in ♂ seventh and eighth segments with a narrow blackened subterminal ring; hypopygium yellow. Male hypopygium (Fig. 39, E). ♂. L. 9-10 mm.; w. 9.5-11 mm. ♀. L. 9.5-12 mm.; w. 10-11.5 mm.

(Late June-early Aug.) Que., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to Va., N. C. and Ind.

D. megaphallus Alex. (Fig. 39, F).
1926. *Dicranoptycha megaphallus* Alexander; Psyche, 33: 57-58.

Generally similar to *sobrina*. Knobs of halteres slightly darkened. Abdominal tergites brown, segments six and seven dark brown; hypopygium yellow. Male hypopygium (Fig. 39, F): outer dististyle relatively long and slender; aedeagus large, outline subrectangular in slide mounts. ♂. L. 7.5-8 mm.; w. 8.5-9.2 mm. ♀. L. about 10 mm.; w. 9.5 mm.

(June-July) N. C., S. C. and Tenn., southw. to n. Fla.

D. minima Alex. (Fig. 39, G).
1919. *Dicranoptycha minima* Alexander; Ent. News, 30: 21-22.

General coloration light brown; praescutum without stripes; dorsal pleurites faintly pruinose, ventral ones more yellowish. Male hypopygium (Fig. 39, G): outer dististyle strongly curved, outer margin entirely smooth; inner dististyle very broad. ♂. L. 6.7-7.2 mm.; w. 6.5-7.8 mm. ♀. L. about 6.5 mm.; w. 7-7.2 mm.

(July-Sept.) Ill., Kan. (Austral).

D. nigripes O. S.
1859. *Dicranoptycha nigripes* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 218.

Fig.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 3, fig. 11 (hyp.); 1869.

General coloration reddish yellow, posterior sclerites of mesonotum and the pleura strongly pruinose. Legs chiefly covered by a dense black pubescence; tip of femur black, preceded by a clearer yellow ring. Anterior border of wing almost ferrugineous; costal fringe (♂) short and dense, black. Abdomen brownish yellow, sternites three to seven with transverse blackened areas at near midlength. Male hypopygium with ninth tergite deeply notched, margin of lobes with short but conspicuous dark setae, median area glabrous. Outer dististyle heavily blackened, strongly curved to apex, outer margin entirely smooth. ♂. L. about 10 mm.

N. C. (Brimley), Ga. (Austral).

D. pallida Alex. (Fig. 39, H).
1926. *Dicranoptycha pallida* Alexander; Psyche, 33: 58-59.

Mesonotum shiny brownish yellow, pleura sparsely pruinose. Remainder of body chiefly pale yellow; eighth abdominal segment (♂) dark brown. Antennae pale yellow. Legs yellow, tips of tibiae narrowly darkened. Costal fringe (♂) short. Male hypopygium (Fig. 39, H). ♂. L. 7-7.2 mm.; w. 7.2-7.8 mm. ♀. L. 9-9.5 mm.; w. 8-8.5 mm.

(July) Ind., Kan. (Austral).

D. septemtrionis Alex. (Figs. 38, F; 39, I).
1926. *Dicranoptycha septemtrionis* Alexander; *Ibid.*, 33: 56-57.

Generally similar to *sobrina*. Mesonotum dark brown, sparsely dusted with gray; pleura pruinose. Legs chiefly yellow, terminal tarsal segments dark brown. Costal fringe (♂) short. Abdominal ter-

gites brown, segments seven to eight (♂) dark brown. Male hypopygium (Fig. 39, I) with outer dististyle conspicuously serrulate on all surfaces. Aedeagus small, subequal in size to lateral arm of tergite. ♂. L. 7-7.5 mm.; w. 8.5-9 mm.

(Aug.-Sept.) Mass., N. Y., westw. to Ind. and Mich., southw. to N. C. (Canadian).

D. sobrina O.S. (Fig. 39, J).
1859. *Dicranoptycha sobrina* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 218.
1859. *Dicranoptycha sororcula* Osten Sacken; *Ibid.*, 1859: 218.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 8 (wing), pl. 3, fig. 12 (hyp.); 1869. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 25, fig. 11 (ven.); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 51 (ven.); 1919.

Head and thorax clear gray, without distinct markings. Abdomen light brown, segments six to eight (♂) more blackened; hypopygium yellow. Male hypopygium (Fig. 39, J). ♂. L. 10-12 mm.; w. 8.5-10.5 mm. ♀. L. 10-13 mm.; w. 9-11 mm.

(June, July) N. J., Pa., Md., Va., Ind., Tenn., southw. to S. C., Ga., and n. Fla. (Transition, Austral).

Connecticut.—A female, presumably of this species, was taken at Newtown, Sept. 15, 1933 (C. P. A.).

Readily told by the clear gray coloration, broadly blackened fore femora, long costal fringe and massive aedeagus of hypopygium.

D. tigrina Alex. (Fig. 39, K).
1919. *Dicranoptycha tigrina* Alexander; Ent. News, 30: 21.

Mesonotum dark brown, with a sparse brown to gray bloom, the posterior notum and pleura clearer gray. Antennae with basal two segments yellow, flagellum black. Wings gray. Subterminal dark ring (♂) involving segments six to eight. Male hypopygium (Fig. 39, K). ♂. L. 9-10 mm.; w. 8.5-10 mm. ♀. L. 10 mm.; w. 9-10 mm.

(June-Sept.) N. C., Tenn., Ind., Ill. and Kan. (Austral).

D. winnemana Alex. (Fig. 39, L).
1916. *Dicranoptycha winnemana* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 500-501.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 12 (ven.); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 50 (wing); 1919.

General coloration pale yellow to brownish yellow; pleura reddish yellow. Antennae with basal two segments usually dark brown, flagellum pale yellow. Legs yellow, terminal tarsal segments brown. Costal fringe (♂) dense and relatively long; *Rs* relatively long, about one-half longer than cell *1st* M_2. Abdomen brownish yellow, segments eight and nine (♂) brownish black. Male hypopygium (Fig. 39, L). ♂. L. 7-8 mm.; w. 7-8.5 mm. ♀. L. 8-9 mm.; w. 8-9 mm.

(June, July) Md., Va., Ind., Ill., N. C. and Tenn., westw. to Mo., southw. to Ga. and n. Fla. (Austral).

This species and *pallida* are so pale in color as to appear almost teneral.

FIGURE 39. Limoniini: *Antocha* (Antocharia) and *Dicranoptycha* (Dicranoptycharia); male hypopygia.

A. *Antocha (Antocha) obtusa* Alex.

B. *A. (A.) opalizans* O. S.

C. *A. (A.) saxicola* O.S.

D. *Dicranoptycha elsa* Alex.

E. *D. germana* O.S.

F. *D. megaphallus* Alex.

G. *D. minima* Alex.

H. *D. pallida* Alex.

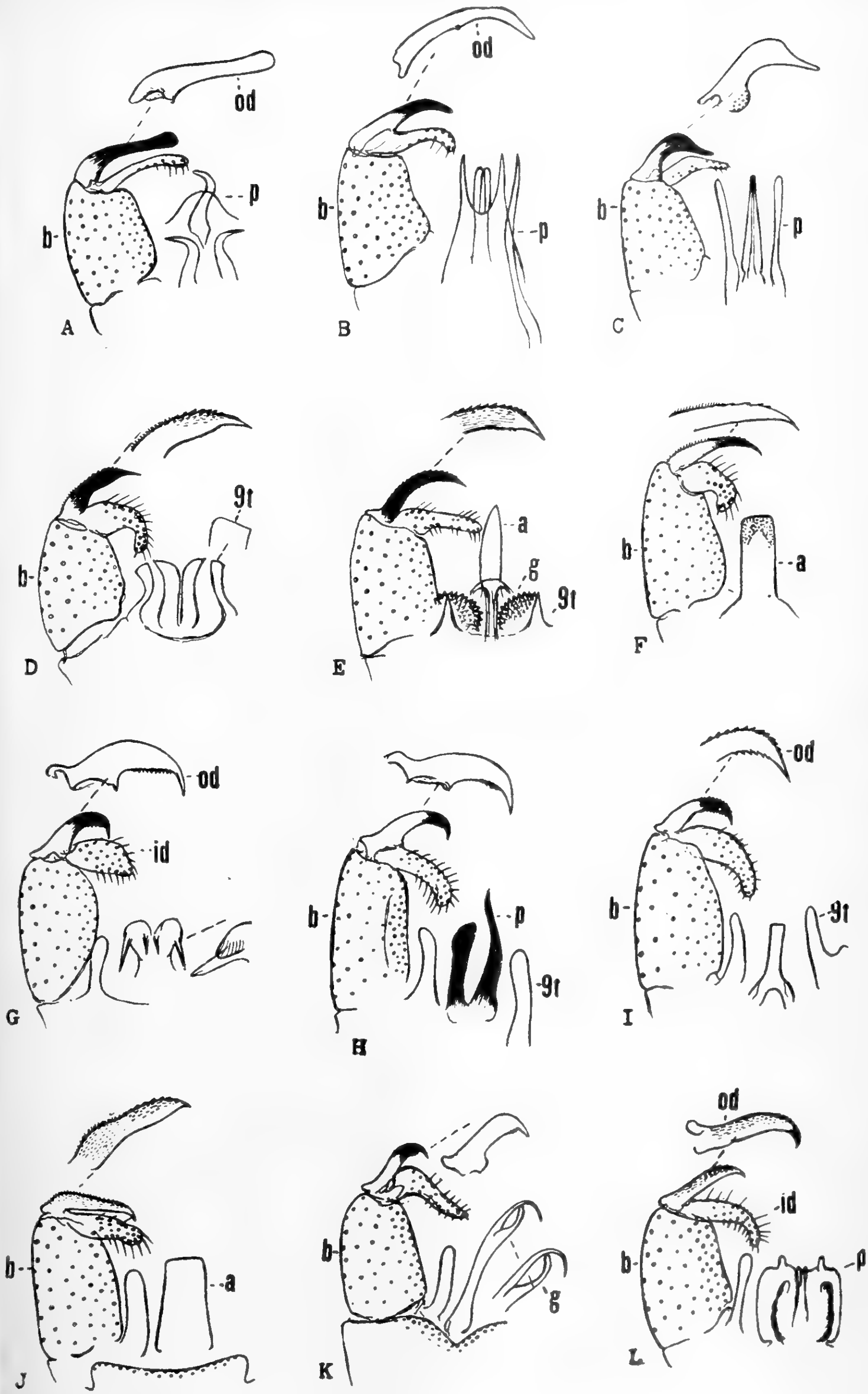
I. *D. septemtrionis* Alex.

J. *D. sobrina* O.S.

K. *D. tigrina* Alex.

L. *D. winnemana* Alex.

Symbols: *a*, aedeagus; *b*, basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *t*, tergite.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6. Subtribe Orimargaria

Orimarga O. S.

1869. *Orimarga* Osten Sacken; Mon. Dipt. N. Amer., 4:120.

Subgenus Diotrepha O. S.

1878. *Diotrepha* Osten Sacken; Cat. Dipt. N. Amer., ed. 2:219-220.

Orimarga is a widely-distributed genus, with representatives in all major faunal areas. *Diotrepha* is found in tropical and subtropical America. A single species enters the southern limits considered in this paper. The local fly is of very strange appearance, most often found by sweeping marshy vegetation in open woodlands. The immature stages are found in decaying wood (see Rogers, Ann. Ent. Soc. America, 20:23-26, pl. 3; 1927).

Orimarga (*Diotrepha*) **mirabilis** (O. S.) (Fig. 38, G).
1878. *Diotrepha mirabilis* Osten Sacken; *Ibid.*, ed. 2:220.

Fig.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 29, fig. 6 (ven.); 1908.

Body very elongate in both sexes. General coloration gray, abdomen more blackened. Legs elongate, white, the tips of femora blackened, bases and tips of tibiae more narrowly so. The somewhat remarkable venation is shown (Fig. 38, G): the recession of *m-cu* towards wing-base readily distinguishes this fly from all others in North America. ♂. L. 7.5-8 mm.; w. 4.5-5 mm. ♀. L. 8.5-9 mm.; w. 5 mm.

(June, July) S. Ind., southw. to Ga., n. Fla. and Tex. (Neotropics: Cuba and Hispaniola).

Pediciini

This very primitive tribe includes a small number of genera and species, well-distinguished by the hairy eyes, unusually long Sc_1, with Sc_2 opposite or before the origin of *Rs*, and the generalized arrangement of veins at the end of *Rs*. Two subtribes, the Ularia and Pedicaria, are maintained as distinct chiefly on characters of the immature stages.

The species of the subgenus *Pedicia* are among the largest and most showy species of Tipulidae within our limits. The members of the subgenera *Tricyphona* and *Nasiternella* are of medium to rather large size, and almost invariably with wings that are patterned, either with a costal darkening or with spots and clouds on the disk. The majority of the local members of the tribe fall within the limits of *Dicranota*, distinguished by the small size and, in most cases, unvariegated wings. The Adelphomyaria, which have been placed in the Pediciini on larval characters, are herein treated as being the most generalized subtribe of Hexatomini.

Key to Subtribes and Genera

1. Wings with membrane covered with abundant macrotrichia (Fig. 40, A) (Ularia) .... **Ula**
   Wings with cells glabrous (Pedicaria) 2

2. Size large (wing, ♂, usually over 7 mm.; in most cases much larger); antennae with 14 or 16 segments; wings usually patterned with darker, either as a costal shading or else spotted and marbled; no supernumerary crossvein in cell R_1; cell *1st* M_2 usually closed (Fig. 40, B-D) ....**Pedicia**
   Size smaller (wing, ♂, under 7 mm.; where larger, with a supernumerary crossvein in Cell R_1); antennae with either 13 or 15 segments; wings usually immaculate, except for the stigmal darkening; cell *1st* M_2 usually open by atrophy of *m* (Fig. 40, E-J) ....**Dicranota**

1. Subtribe Ularia

Ula Haliday

1833. *Ula* Haliday; Ent. Mag., 1:153.

The genus *Ula* is very isolated in its affinities, in its various stages curiously combining the characters of the two tribes Pediciini and Hexatomini. The structure of the adult, especially the hairy eyes and general conformation of the male hypopygium, is very like the Pediciini. However, other features, especially of the larva, are more essentially Hexatomine.

The immature stages of the various species of *Ula* are found in decaying fungi. The adult flies are especially numerous in Spring and Fall, being most often swept from yew and other low-growing evergreen shrubs in cold woods and ravines.

Key to Species

1. Antennae short in both sexes, if bent backward ending before the root of the halteres; wings with the cord and outer end of cell *1st* M_2 seamed with brown ....**elegans**
   Antennae of male elongate, if bent backward extending to beyond the base of the abdomen; wings dusky, without a distinct pattern except the stigmal clouding 2
2. Mesonotum brownish, the praescutum with a broad, clearly defined, shiny brown median stripe; antennae uniformly dark brown, including the scape and pedicel; in male of unusual length, if extended backward reaching about to midlength of abdomen ....**longicornis**
   Mesonotum grayish brown, without clearly defined darker stripes; antennae dark brown, the scape and pedicel clear light yellow; in male relatively long, if bent backward extending about to the base of the third abdominal segment (Fig. 40, A) ....**paupera**

Ula elegans O. S.

1869. *Ula elegans* Osten Sacken; Mon. Dipt. N. Amer., 4:276-277.

Figs.—Alexander, Cfls. N. Y., 1, pl. 41, fig. 164 (wing); 1929. Dickinson, Cfls. Wisc., p. 200, fig. 90 (wing); 1932.

Antennal verticils exceeding the segments; brownish black, the two basal segments clear yellow; head clear gray. Thorax dark brown, with a yellowish pollen, the stripes ill-delimited. The darkened wing-pattern varies much in the degree and intensity of the areas, usually including the cord, outer end of cell *1st* M_2, origin of *Rs*, and both ends of the otherwise yellowish stigma. Male hypopygium with the gonapophyses long and conspicuous, the outer pair simple, the inner pair prolonged into needle-like points, before apex with an acute erect to slightly recurved spine. ♂. L. about 5-6 mm.; w. 6-7 mm. ♀. L. about 6-7 mm.; w. 7-8 mm.

(Apr.-June; Aug.-Sept.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Alta. and Mont., southw. to S. C. and Tenn.

Connecticut.—Riverton, May 16, 1931 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.); Tunxis State Forest, May 16, 1931 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

U. longicornis Dtz.
1921. *Ula longicornis* Dietz; Trans. Amer. Ent. Soc., 47:250-251.

♂. L. about 5 mm.; w. 6.5 mm.

(Early Aug.) Pa. (mts.). Known only from the unique type.

U. paupera O. S. (Fig. 40, A).
1869. *Ula paupera* Osten Sacken; Mon. Dipt. N. Amer., 4:277-278.

Antennae of ♂ with flagellar segments elongate-fusiform, with an erect pale pubescence and short, inconspicuous verticils. Wings very rarely with dusky cloud on anterior cord. Male hypopygium with the gonapophyses small and inconspicuous. ♂. L. 5-6 mm.; w. 6-7.5 mm. ♀. L. 6-7 mm.; w. 6-6.5 mm.

(Apr.-May; Aug.-Sept.) Que., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to D. C.

Connecticut.—E. Hartland, Sept. 11, 1928 (C. P. A.); Norfolk, Sept. 12, 1928 (C. P. A.); Riverton, Sept. 11, 1928, May 16, 1931 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); W. Granby, Sept. 11, 1928 (C. P. A.).

2. Subtribe Pedicaria

Pedicia Latr.

1809. *Pedicia* Latreille; Hist. Nat. Crust. et Ins., 4:255.

Key to Subgenera

1. Size very large (wing, 20 mm. or more); wings with a dark pattern that is arranged as a triangle, including broad costal and cubital seams that are connected across the very oblique cord; maxillary palpi with terminal segment elongate (Fig. 40, B) .... **Pedicia**
   Size smaller (wing, under 18 mm., usually under 15 mm.); wings never with a dark pattern distributed as above described; cord transverse or nearly so (Fig. 40, C, D); maxillary palpi with terminal segment short............. 2
2. Wings with a supernumerary crossvein in cell M .... **Nasiternella**
   No supernumerary crossvein in cell M of wings .... **Tricyphona**

Subgenus **Pedicia** Latreille

The subgenus *Pedicia* includes three local species that are among the largest and most conspicuous of our crane-flies. All are readily told by the dark brown triangle on the wings, this being produced by a dark costal margin and a broad seam along vein Cu, cross-connected by a similar dark seam along the unusually oblique cord. The adult flies show some features that strongly suggest the subfamily Tipulinae, notably the elongate maxillary palpi and the shirring of vein Cu_1 at the point of insertion of $m\text{-}cu$. The flies frequent wet woods, boggy areas, the shaded springy slopes of open gorges and similar situations that include cold springs or saturated springy hillsides supporting a mossy growth, wherein the large carnivorous larvae are to be found.

Key to Species

1. Dark seam along vein[1] *Cu* not extending distad beyond the approximate level of the cord; intermediate praescutal stripes broad and almost confluent. **contermina**

   Dark seam along vein *Cu* extended distad onto the outer section of vein Cu_1; intermediate praescutal stripes distinct 2
2. Dark seams along *Cu* and the cord broad, the former extending the entire length of the vein and thus attaining the wing-margin; intermediate praescutal stripes darker in color than the laterals ....**albivitta**

   Dark seams along *Cu* and the cord narrow, the former ending at about midlength of the distal section of vein Cu_1, not attaining the wing-margin; intermediate praescutal stripes concolorous with the laterals ....**margarita**

While the present report was in press, a fourth species of *Pedicia* has been added to the present faunal area. This has been described as *Pedicia* (*Pedicia*) *procteriana* Alexander (Bull. Brooklyn Ent. Soc., 36; April 1939). By the above key, the species runs to *contermina*, from which it is distinguished by the very deep cell M_4 of wings and, especially, by the distinct structure of the male hypopygium. It is known only from Ontario (Ide) and Mount Desert Island, Me. (William Procter). This species is on the wing from late May into July.

Pedicia (*Pedicia*) **albivitta** Walker.
1848. *Pedicia albivitta* Walker; List Dipt. Brit. Mus., 1:37.

Figs.—Aldrich, Psyche, 7:201, text-fig. (wing); 1895. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 26, fig. 1 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3:80, fig. 1 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 42, fig. 175 (wing); 1919. Young, Cornell Univ. Agr. Expt. Sta. Mem. 44:283, pl. 9, figs. 1, 2 (thorax); 1921. Dickinson, Cfls. Wisc., (col. frontispiece, ad. ♀); 1932.

Mesonotum whitish gray; pleura light gray, the dorso-pleural region blackened. Antennae short, scape brown, flagellum obscure yellow. Head gray, with a small dark vertical tubercle. Halteres pale. Femora yellow, tips conspicuously blackened. Abdomen whitish gray, the tergites with triangular or diamond-shaped darker gray areas that are bordered by rusty-yellow, this color most extensive at incisures. ♂. L. 24-28 mm.; w. 23-24 mm. ♀. L. 30-35 mm.; w. 23-27 mm.

(July-Sept.) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Man., Minn., Wisc., Ia., Mo. and Kan., southw. to Va., N. C., and S. C.

Connecticut.—Cornwall Bridge, Aug. 9, 1931 (C. P. A.); E. Hartland, Sept. 11, 1928 (C. P. A.); East River, Sept. 10 (Ely); New Haven, Sept. 12, 1904 (B. H. W.); New London (O. S.); Salisbury, Aug. 27, 1904 (W. E. B.), Sept. 5, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Storrs, 1929 (L. S.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

P. (*Pedicia*) **contermina** Walk.
1848. *Pedicia contermina* Walker; List Dipt. Brit. Mus., 1:38.

Fig.—Alexander, Cfls. N. Y., 1, pl. 42, fig. 176 (wing); 1919.

Long held to be a mere variation of *albivitta*, now known to be distinct. Wings with the pale brownish yellow costal border extending to beyond the stigma. ♂. L. 26-30 mm.; w. 25-26 mm. ♀. L. 28-30 mm.; w. about 26 mm.

(May-July) Que., N. S., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to N. C.

P. (*Pedicia*) **margarita** Alex. (Fig. 40, B).
1929. *Pedicia margarita* Alexander: Bull. Brooklyn Ent. Soc., 24: 300-302.

Closely related to *albivitta*, differing in the small size and nature of wing-pattern. Median praescutal stripes entirely pale reddish brown. Knobs of halteres dusky. Wings relatively narrow, the dark markings correspondingly reduced in width. ♂. L. about 20-22 mm.; w. 20-22 mm. ♀. L. about 24 mm.; w. 21.5-22 mm.

(Late July-Aug.) N. B., Me., N. H., Vt., Mass., N. Y., southw. to Tenn. (Great Smokies).

Subgenus **Nasiternella** Wahlgren

1881. *Nasiterna* Wallengren; Ent. Tidskr., 2:179; (nec *Nasiterna* Wagler, 1832).
1904. *Nasiternella* Wahlgren; Arkiv för Zoologi., 2, No. 7 : 4.

The subgenus *Nasiternella* includes the single species *hyperborea*. The female, first detected in 1933 on Mt. Washington, is subapterous.

Pedicia (*Nasiternella*) **hyperborea** (O. S.)
1861. *Amalopis hyperborea* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861 : 292.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 50 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 182 (wing); 1919.

General coloration gray, praescutum with broad brown stripes. Antennae brown. Head gray. Halteres elongate, pale. Wings whitish, handsomely clouded and marbled with brown, including a heavier costal series. Cell *1st* M_2 normally closed, rarely open by atrophy of *m*. Abdomen dark brown, segments narrowly ringed caudally with paler. ♂. L. 8-9 mm.; w. 10.5-12 mm. ♀. L. about 8 mm.; w. 3.2 mm.

(Late June, July) Labr., westw. to Can. N. W. Terr., southw. to Mt. Washington, N. H. (2800′-4200′), Vt. (Killington Peak) and N. Y. (Adirondacks, Mt. Marcy, Mt. Whiteface). (Hudsonian).

Subgenus **Tricyphona** Zetterstedt

1838. *Tricyphona* Zetterstedt; Ins. Lapponica, Dipt., p. 851.
1856. *Amalopis* Haliday; Ins. Brittanica, Dipt., 3, add., p. xv.

The various local species of *Tricyphona* are about intermediate in size between the local species of the subgenus *Pedicia* and the forms included in the genus *Dicranota*. The flies of our species all have cell *1st* M_2 closed, except in abnormal specimens. The adults occur in swampy and boggy areas, a few species (as *vernalis*) along rocky mountain streams; others (as *auripennis*) found resting on the wet faces of vertical cliffs. The larvae are found in wet earth.

Key to Species

1. Wings with a conspicuous brown costal darkening; *r-m* connecting with *Rs* before fork; a short element R_{2+3+4}. (Fig. 40, C) 2

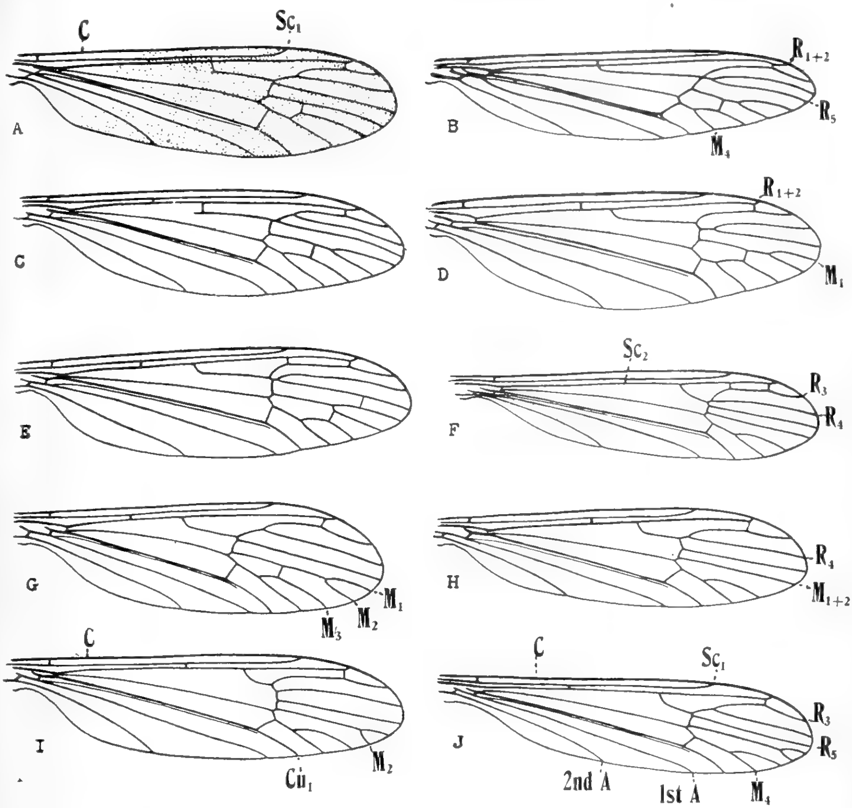


FIGURE 40. Pediciini; venation.

A. *Ula paupera* O.S.
B. *Pedicia (Pedicia) margarita* Alex.
C. *P. (Tricyphona) inconstans* (O.S.)
D. *P. (T.) calcar* (O.S.)
E. *Dicranota (Eudicranota) notabilis* Alex.
F. *D. (Paradicranota) eucera* O.S.
G. *D. (Amalopina) flaveola* (O.S.)
H. *D. (Plectromyia) modesta* (O.S.)
I. *D. (Rhaphidolabis) cayuga* (Alex.)
J. *D. (R.) tenuipes* (O.S.)

Symbols: *A*, Anal; *C*, Costa; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

Wings subhyaline, or else variegated with brown spots and clouds, the costal region not conspicuously darkened; *r-m* connecting with *Rs* at, or, usually, beyond the fork; R_{4+5} forming a symmetrical fork with R_4, not captured by R_{2+3}. (Fig. 40, D) 3

2. Wings narrow; a variable number of supernumerary crossveins in cell R_4; male hypopygium with the tergite narrowed outwardly, without lateral notches (Fig. 41, D) .... **johnsoni**

Wings of normal width, without supernumerary crossveins in cell R_4; male hypopygium with the caudal margin of tergite broadly and gently emarginate, fringed with numerous setulae, and with small lateral notches (Fig. 41, E) .... **inconstans**

3. Wings yellowish, unmarked except for the stigma and a slight yellowish costal suffusion 4

Wings with brown spots, appearing as seams to certain of the veins, narrowest and least evident in *katahdin* and *pumila* 5

4. Stigmal area of wings brown; male hypopygium conspicuously hairy, the dististyle with four or five prongs (Fig. 41, B); wings (♀) small and tending to be atrophied (wing, ♀, under 10 mm.) .... **autumnalis**
   Stigmal area of wings usually pale to feebly indicated; male hypopygium small, not conspicuously hairy; wings (♀) of normal size, over 12 mm.. **calcar**
5. Cell M_3 long-petiolate, M_{3+4} longer than *m-cu*; wing-pattern chiefly as a broad brown seam along cord; size large (wing, ♂, over 13 mm.) .... **auripennis**
   Cell M_3 sessile or short-petiolate, M_{3+4} very short or lacking; wing-pattern without a conspicuous brown seam along cord; size smaller (wing, ♂, under 10 mm.) 6
6. Wings with a heavy brown pattern, including large circular clouds at Sc_2 and origin of *Rs*, the latter not crossing cell *C*; abdominal segments gray, conspicuously banded with paler; basal two antennal segments yellow, the remainder black .... **vernalis**
   Wings with a restricted brown pattern, extensive only in *macateei*, where the area at Sc_2 crosses cell *C* to the margin; abdominal segments brown or brownish black throughout (except in *katahdin*, where the basal segment is pale) 7
7. Wing-pattern heavy, especially a costal series of about five darkenings, some of these (at least that at Sc_2) reaching the front margin of wing.... **macateei**
   Wing-pattern very restricted, including only small spots and dots at intervals along veins, with cells *C* and *Sc* nearly clear 8
8. General coloration light brown, including the pleura; antennal scape pale yellow, the remainder of organ black .... **katahdin**
   General coloration of body gray; antennae entirely dark brown or black 9
9. Wings of normal size (wing, ♂, 8-9 mm.); antennae 16-segmented.. **paludicola**
   Wings small and showing signs of degeneracy both of shape and venation (wing, ♂, about 5 mm.); antennae 14-segmented .... **pumila**

Pedicia (*Tricyphona*) auripennis (O. S.) (Fig. 41, A).

1859. *Amalopis auripennis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 247.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 49 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 181 (wing); 1919.

Mesonotum yellowish gray, the praescutum with three conspicuous brown stripes; pleura yellowish gray, sparsely variegated with brown. Basal antennal segments brownish yellow, the outer segments brownish black. Head gray. Halteres pale. Legs obscure yellow, femoral tips very narrowly darkened. Abdomen generally light brown, tergites darker, their caudal margins narrowly ringed with paler, of sternites more yellowish. Male hypopygium (Fig. 41, A). ♂. L. 15-17 mm.; w. 13.5-17 mm. ♀. L. 18 mm.; w. 16 mm.

(June) Ont., Que., Me., N. H., Vt., Mass., N. Y.

Connecticut.—W. Granby, June 8, 1929 (G. C. C.); resting on face of mossy cliff.

P. (*Tricyphona*) autumnalis (Alex.) (Fig. 41, B).

1917. *Tricyphona autumnalis* Alexander; Can. Ent., 49: 30-31, 61-62.

Figs.—Alexander, Cfls. N. Y., 1, pl. 42, fig. 179 (wing ♂), fig. 180 (wing ♀); 1919. Dickinson, Cfls. Wisc., p. 208, fig. 106 (wing); figs. 161, 162 (hyp.); 1932.

General coloration of thorax pale yellow, the praescutum pale with three very indistinct reddish yellow stripes. Antennae with basal segments yellow, terminal ones black. Head light gray. Knobs of halteres infuscated. Wings yellowish subhyaline, costal region more saturated; stigma brown; petiole of cell R_4 subequal to *r-m*. Abdom-

inal tergites brown, sternites yellow; terminal segments dark brown. Male hypopygium (Fig. 41, B) having unusually long setae on basistyle. ♂. L. 13.5-16 mm.; w. 13.5-15 mm. ♀. L. 20 mm.; w. 9.5 mm.

(Late July-Oct.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y. and Pa., westw. to Mich., Wisc. and Hudson's Bay.

P. (*Tricyphona*) **calcar** (O. S.) (Figs. 40, D; 41, C).
1859. *Amalopis calcar* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 247.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 14 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 25, fig. 2 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3,: 84, fig. 25, sub 4 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 48 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 178 (wing); 1919. Dickinson, Cfls. Wisc., p. 208, fig. 107 (wing); 1932.

General coloration of thorax pale yellow, the praescutum with four slightly more reddish stripes, the interspaces weakly pruinose. Antennae chiefly pale yellow, outer segments brown. Head gray. Wings (Fig. 40, D) tinged with yellow; cell R_4 short-petiolate. Abdomen brown above, tergites laterally and the sternites yellow; subterminal segments dark brown. Male hypopygium (Fig. 41, C). ♂. L. 10-13 mm.; w. 11-14 mm. ♀. L. 15-18 mm.; w. 13.5-15 mm.

(May, June) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Wisc., southw. to N. C.

Connecticut.—Cornwall Bridge, May 30, 1931 (C. P. A.), June 12-13, 1931 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, May 30, 1931 (C. P. A.); Storrs, May 1931 (C. S. C.); Tyler Lake, May 30, 1931 (C. P. A.).

P. (*Tricyphona*) **inconstans** (O. S.) (Figs. 40, C; 41, E).
1859. *Amalopis inconstans* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 247.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 30 (♂ hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 25, fig. 1 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 47 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 177 (wing); 1919. Dickinson, Cfls. Wisc., p. 209, fig. 108 (wing); 1932.

General coloration of notum yellow to yellowish orange, pronotum darkened medially. Antennae yellow, basal segments darker. Head brownish gray. Halteres and legs yellow. Wings (Fig. 40, C) subhyaline, costal border broadly and conspicuously infuscated; restricted brown dots at origin *Rs* and on anterior cord. Abdominal tergites brown, basal sternites paler. Male hypopygium (Fig. 41, E). ♂. L. 11-14 mm.; w. 10-12 mm. ♀. L. 13-16 mm.; w. 11-14 mm

(May-Sept.) Ont., Que., Nfd., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Wisc., Minn. and Mo., southw. to S. C. and Ga.

Connecticut.—Danbury, June 15, 1909 (C. W. J.); East River, July 6, 1911 (Ely); Hamden, June 2, 1928 (R. B. F.); Kent Falls, Sept. 11, 1929 (A. J. W.); Manitic Lake, June 8-9, 1929 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.);

FIGURE 41. Pediciini; male hypopygia.

A. *Pedicia (Tricyphona) auripennis* (O.S.)

B. *P. (T.) autumnalis* (Alex.); dististyle.

C. *P. (T.) calcar* (O.S.); dististyle.

D. *P. (T.) johnsoni* (Alex.); tergite.

E. *P. (T.) inconstans* (O.S.)

F. *P. (T.) paludicola* (Alex.)

G. *Dicranota (Paradicranota) iowa* Alex.

H. *Pedicia (Tricyphona) vernalis* (O.S.)

I. *Dicranota (Paradicranota) eucera* O.S.

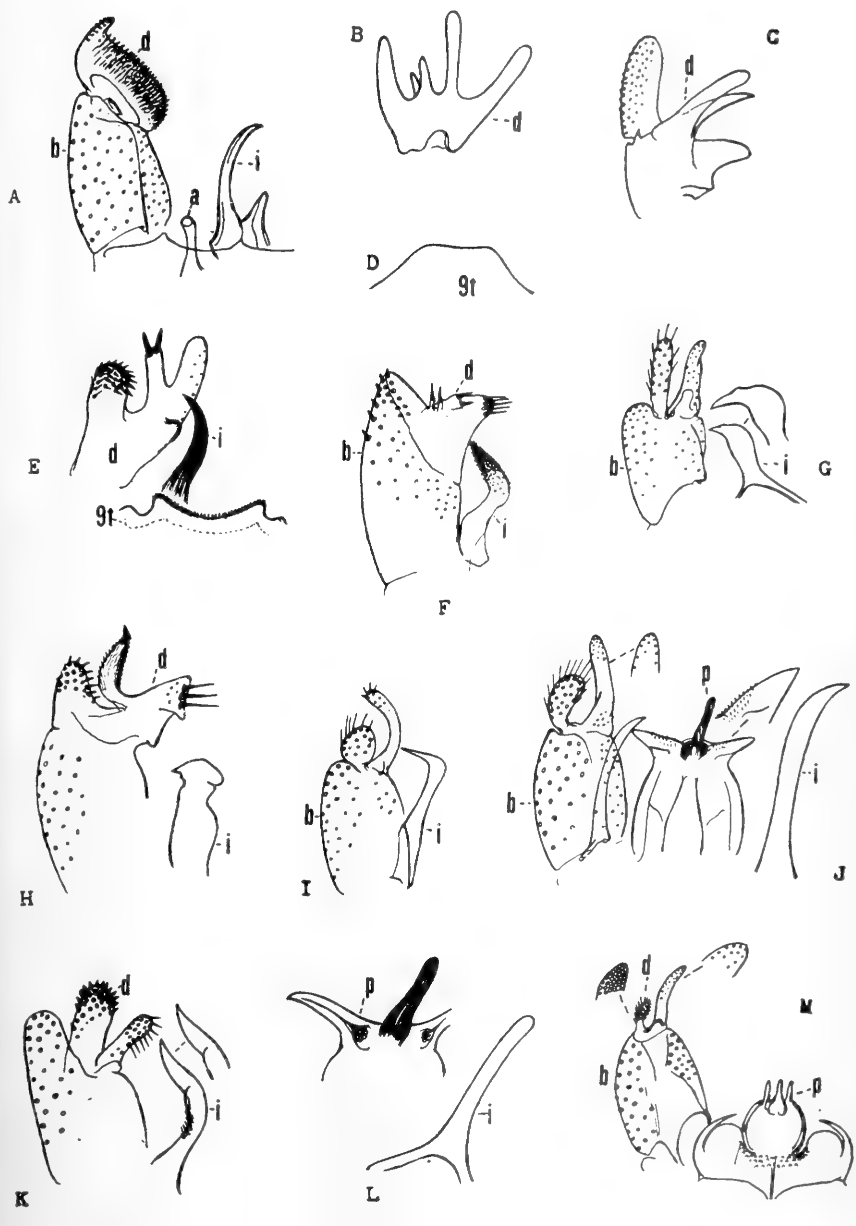
J. *D. (Dicranota) currani* Alex.

K. *D. (Paradicranota) rivularis* O.S.

L. *D. (Dicranota) divaricata* Alex.

M. *D. (D.) noveboracensis* Alex.

Symbols: *a,* aedeagus; *b,* basistyle; *d,* dististyle; *i,* interbase; *p,* phallosome; *t,* tergite.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N. Branford, July 4, 1924 (R. B. F.); Norfolk, June 9, 1929 (C. P. A.); Putnam, June 15, 1933 (C. P. A.); Riverton, May 30, June 12, 1931 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.); Sept. 12, 1928 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Tunxis State Park, June 12-13, July 23, 1931 (C. P. A.); Tyler Lake, May 30, 1931 (C. P. A.); Union, Aug. 17, 1928 (C. S. C.); Westbrook, June 5, 1929 (R. B. F.); W. Granby, Sept. 11, 1928 (G. C. C.), June 8, 1929 (C. P. A.).

P. (*Tricyphona*) **johnsoni** Alex. (Fig. 41, D).

1930. *Tricyphona johnsoni* Alexander; Occas. Pap. Boston Soc. Nat. Hist., 5: 277.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 15 (wing); 1869, (as *inconstans*). Johnson, Psyche, 34: 217, figs. 1-4 (wings); 1927, (as *inconstans*).

Generally similar to *inconstans*, differing as follows: wings narrower, the coloration darker, including the somewhat broader costal border; cell R_4 with from one to seven supernumerary crossveins. Male hypopygium with the tergite (Fig. 41, D).

(June) Mass. (Nantucket Is.), southw. to flatwoods areas of S. C., Ga. and Fla. (coastal).

P. (*Tricyphona*) **katahdin** Alex.

1914. *Tricyphona katahdin* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 598-599.

Figs.—Alexander, *Ibid.*, 1914, pl. 25, fig. 7 (wing). Alexander, *Ibid.*, 1916, pl. 28, fig. 51 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 183 (wing); 1919.

Mesonotum light fawn-brown, praescutal stripes very ill-defined, the pleura light yellow. Antennae with basal segment yellow, remainder dark brown. Knobs of halteres weakly darkened. Femora yellow basally, passing into brown. Wings light yellow, with a few small brown spots, chiefly along anterior half; venation variable, *m-cu* at or before fork of M, cell M_3 subsessile to long-petiolate. Abdominal tergites weakly bicolorous, brown, the apices broadly pale; sternites brownish yellow; margined laterally with brown. Male hypopygium almost as in *paludicola*. ♂. L. 6-7.5 mm.; w. 6-7 mm. ♀. L. 8.8-9.5 mm.; w. 7.5-9 mm.

(Aug.) Me., Vt., westw. to Mich.

P. (*Tricyphona*) **macateei** Alex.

1919. *Tricyphona macateei* Alexander; Can. Ent., 51: 166.

Mesonotum yellowish gray, the praescutum with four brown stripes, intermediate pair only narrowly separated. Antennae brownish black throughout. Head dark gray. Femora brownish yellow, tips broadly dark brown. Wings nearly hyaline, with a heavy dark brown pattern. Cell M_3 sessile; *m-cu* at or before fork of M. Abdominal tergites brownish gray, the caudal margins more yellowish gray. Male hypopygium almost as in *paludicola*. ♂. L. 8-8.5 mm.; w. 8-9 mm. ♀. L. 9-10 mm.; w. 10-11 mm.

(Early May; Sept., Oct.) Mass., N. Y., southw. to Md. and N. C.

Connecticut.—W. Granby, Sept. 11, 1928 (G. C. C.).

P. (*Tricyphona*) **paludicola** (Alex.) (Fig. 41, F).
1916. *Tricyphona paludicola* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 538-540.

Figs.—Alexander, *Ibid.,* 1916, pl. 28, fig. 53 (wing). Alexander, Cfls. N .Y., 1, pl. 42, fig. 184 (wing); 1919.

General coloration brownish gray, the praescutum with four brown stripes; pleura gray. Head brownish gray. Knobs of halteres infuscated. Femora obscure yellow, tips broadly brownish black. Wings sometimes nearly unimaculate; cell M_3 sessile. Abdomen dark brown, including hypopygium. Male hypopygium (Fig. 41, F) with apex of basistyle set with microscopic black spines; dististyle bearing two or three small spines or spinous plates; interbase with abundant setae on distal half. ♂. L. 7-8 mm.; w. 8-9 mm. ♀. L. 10.5-11 mm.; w. 10.5-11 mm.

(May-early June). Ont., N. B., Me., Vt., Mass., N. Y., westw. to Mich.

The four species, *katahdin*, *macateei*, *paludicola* and *pumila*, all have this peculiar type of hypopygium and are unquestionably closely allied, being best separated by the characters given in the key.

P. (*Tricyphona*) **pumila** sp. nov.

Rostrum brownish gray; palpi dark brown. Antennae 14-segmented, dark brown throughout; flagellar segments oval, the outer ones more narrowed; terminal segment longer than the penultimate. Head yellowish gray, the center of vertex extensively infuscated; a weak low carina on vertex, possibly abnormal.

Pronotum brownish gray, the central portion a little darker. Mesonotal praescutum gray with four brown stripes, the median line more brownish gray; posterior sclerites of mesonotum clearer gray, the center of each scutal lobe with a brown triangular area. Pleura gray, the dorso-pleural region more yellowish. Halteres obscure yellow, the knobs infuscated. Legs with coxae brownish gray; trochanters brownish yellow; femora brownish black, the basal portions brighter; remainder of legs black. Wings narrow, whitish subhyaline, with a very restricted brown pattern that is chiefly costal, including small spots at ends of veins *Sc*, R_{1+2} and as narrow vague seams along the cord; veins pale brown. Venation: tending to be degenerate; petiole of cell R_4 elongate, exceeding cell *1st* M_2.

Abdomen brownish gray, including the hypopygium. Male hypopygium much as in *katahdin;* dististyle broadly flattened and provided with two or three spines; setae of interbasal process very dense but of moderate length only; aedeagus capitate. ♂. L. about 5.5 mm.; w. 5 x 1 mm.

Holotype, ♂. near Woodstock, New Brunswick, June 15, 1929 (C. P. A.); in author's collection.

The species belongs to the *paludicola* group, being most closely allied to the typical member, *paludicola*. It is the smallest and most degenerate species of the genus so far discovered in Eastern North America. More recent observations made in Michigan by Professor Rogers indicate the probability that *pumila* is scarcely distinct from *paludicola*.

P. (*Tricyphona*) **vernalis** (O. S.) (Fig. 41, H).
1861. *Amalopis vernalis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861: 291.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 52 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 42, fig. 185 (wing); 1919.

General coloration gray, the praescutum with three brown stripes, median stripe rarely divided by a pale vitta. Head brownish gray. Wings with a faint brown tinge, heavily spotted with darker brown. *M-cu* connecting with M_4 just beyond base; cell *1st* M_2 in cases open by atrophy of *m*. Male hypopygium (Fig. 41, H) with the dististyle bearing a slender, setiferous, tail-like lobe. ♂. L. 6.5-7.5 mm.; w. 8-9 mm. ♀. L. 11-12 mm.; w. 10.5-12 mm.

(Late May, June) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., southw. to N. C., S. C. and Ga.

Connecticut.—Hartland, June 9, 1929 (C. P. A.).

Dicranota Zetterstedt

1838. *Dicranota* Zetterstedt; Ins. Lapponica, Dipt., p. 851.

The uniting of several groups of small crane-flies into the single genus *Dicranota* has rendered this the largest genus within the tribe, with nearly a score of species occurring in our faunal limits. The members of the genus are readily told from the larger Pediciini by the usually unvariegated wings, generally open cell *1st* M_2, and small size. The antennal structure, including number of segments, is remarkably variable among the different species. Similarly the venation is highly plastic, especially as regards the radial field, and most of the subgeneric groups here recognized are separated on slight details of venation. Such groups are admittedly artificial and are maintained chiefly for convenience in handling the unwieldy mass of species. Occasionally abnormal specimens are found in a series but since more than a single, or even several, species may be taken at a single place and date, the identification should be checked by a study of the male hypopygium. The adult flies occur along woodland streams, in gorges, in boggy areas, and similar ecological situations. The carnivorous larvae live in the wet soil in or near such places.

Key to Subgenera

1. A supernumerary crossvein in cell R_1 about opposite end of vein Sc_1 2
   No supernumerary crossveins in cells of wing 4
2. Cell *1st* M_2 closed (Figs. 23, C; 40, E) ...... **Eudicranota**
   Cell *1st* M_2 open by atrophy of *m* 3
3. Cell M_1 lacking (Fig. 40, F) ...... **Paradicranota**
   Cell M_1 present ...... **Dicranota**
4. Cell *1st* M_2 closed (Fig. 40, G) ...... **Amalopina**
   Cell *1st* M_2 open by atrophy of *m* 5
5. Cell M_1 lacking (Fig. 40, H) ...... **Plectromyia**
   Cell M_1 present (Fig. 40, I, J) ...... **Rhaphidolabis**

Subgenus **Eudicranota** Alex.

1934. *Eudicranota* Alexander; in Curran, Keys to the Families and Genera of North American Diptera, p. 40.

Distinguished from *Dicranota*, s.s., by the closed cell *1st* M_2 and 15-segmented antennae. Within the limits of this group is to be found almost the whole range of position of vein R_4 to be found in the tribe. this being retained in its primitive position on the posterior fork by *notabilis*, while being extensively captured by the upper fork, forming a long element R_{2+3+4}, in *pallida*.

Type of subgenus.—*Dicranota notabilis* Alexander (Eastern Nearctic).

Both known species occur within our limits or are regional. The only other member of the genus with cell *1st* M_2 closed, is *Amalopina*, which lacks the supernumerary crossvein in cell R_1 and has cell M_1 long-petiolate. *Eudicranota* has the cell very short-petiolate to sessile.

Key to Species

1. A short fork of R_{4+5}, cell R_4 thus being short-petiolate, R_3 sessile (Fig. 40, E) .... **notabilis**
   R_4 captured by R_{2+3}, forming a long fusion of R_{2+3+4}, cell R_3 thus being long-petiolate, R_4 sessile (Fig. 23, C) .... **pallida**

Dicranota (*Eudicranota*) **notabilis** Alex. (Fig. 40, E).
1929. *Dicranota notabilis* Alexander; Can. Ent., 61: 18.

General coloration pale yellow. Halteres and legs yellow: tips of femora and tibiae weakly infumed. Wings pale yellow, the base and costal region a trifle darkened; stigmal area and veins of cord a little suffused; cell M_1 broadly sessile. ♀. L. about 10 mm.: w. 9.5 mm.

(June) Tenn.

D. (*Eudicranota*) **pallida** Alex. (Fig. 23, C).
1914. *Dicranota pallida* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 599-600.

Figs.—Alexander, *Ibid.*, 1914, pl. 27, fig. 31 (wing). Alexander, Cfls. N. Y., 1, pl. 41, fig. 167 (ven.); 1919.

General coloration pale yellow, scutal lobes, base of scutellum and postnotum more infuscated; pleura yellow. Femora yellow, a little darkened at tips. Wings hyaline, iridescent, costal margin a trifle infumed, especially basally; *Rs* long, angulated and spurred at origin; cell M_1 nearly sessile (Fig. 23, C). ♀. L. 8 mm.; w. 8 mm.

(July) Me. (Mt. Desert), N. H. (White Mts.)

Subgenus **Paradicranota** Alex.

1934. *Paradicranota* Alexander; in Curran, Keys to the Families and Genera of North American Diptera, p. 40.

Distinguished from *Dicranota*, s.s., by the loss of cell M_1 of wings.

Type of subgenus.—*Dicranota rivularis* Osten Sacken (Eastern Nearctic).

A weak division of the genus, paralleling *Plectromyia* in the *Rhaphidolabis* group of species. The subgenus includes a few European species (*longitarsis* Bergroth, *robusta* Lundström) and other Nearctic forms (as *eucera* Osten Sacken and *iowa* Alexander). Within the group are found species with elongate antennae in ♂ and others with the organ short in both sexes.

Key to Species

(Based chiefly on male characters)

1. Halteres pale; antennae short in both sexes, if bent backward ending some distance before wing-root; male hypopygium with outer angle of basistyle produced into a lobe (Fig. 41, K) .... **rivularis**
   Halteres with knobs weakly to strongly infuscated; antennae (♂) elongate, if bent backward extending to some distance beyond base of abdomen; male hypopygium without lobe on basistyle (Fig. 41, G, I) 2
2. Wings unmarked except for the pale brown stigma; mesonotal praescutum with three brown stripes; male hypopygium with inner dististyle elongate, approximately twice the small oval outer style; interbase with a long slender stem, the acute apex bent at a right angle (Fig. 41, I) .... **eucera**
   Wings with a brown seam on anterior cord, additional to the dark brown stigma; mesonotal praescutum with four brown stripes, the intermediate pair approximated; male hypopygium with both dististyles nearly equal in length; interbase a short, powerful, beak-like blade (Fig. 41, G) .... **iowa**

Dicranota (*Paradicranota*) **eucera** O. S. (Figs. 40, F; 41, I).

1869. *Dicranota eucera* Osten Sacken: Mon. Dipt. N. Amer., 4: 281-282.

Fig.—Dickinson, Cfls. Wisc., p. 209, fig. 109 (wing); 1932.

General coloration of mesonotum gray; pleura gray. Antennae dark throughout; in ♂ elongated, if bent backward extending about to base of third abdominal segment, of ♀ short, extending about to wing-root. Wings with a weak brownish tinge, stigma darker; *Rs* short, angulated at origin; cell R_3 short to very short petiolate. Abdomen dark brown. Male hypopygium (Fig. 41, I). ♂. L. about 5-5.5 mm.; w. 6-7 mm.; antenna about 3 mm. ♀. L. 6-6.5 mm.; w. 7-7.5 mm.

(Apr., May) Mass., westw. to Minn., southw. to Md., Va. and N. C. Wisconsin records (Dickinson, l. c.) pertain to the next species (Rogers, *in litt.*).

D. (*Paradicranota*) **iowa** Alex. (Fig. 41, G).

1920. *Dicranota iowa* Alexander; Can. Ent., 52: 78-79 (♀).

1921. *D. rogersi* Alexander; *Ibid.*, 53: 136 (♂).

Generally similar to *eucera* in the elongate antennae of male. Male hypopygium (Fig. 41, G). ♂. L. 5.5-6.5 mm.; w. 6-7.5 mm. ♀. L. 7.5-8.5 mm.; w. 8-10 mm.

(June-Aug.) Que., westw. to Mich., Wisc., Minn., and Ia., southw. to Hudsonian Zone of Mt. Washington, N. H.

D. (*Paradicranota*) **rivularis** O. S. (Fig. 41, K).
1859. *Dicranota rivularis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 281.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 16 (wing); 1869. Williston, Man. N. Amer. Dipt., Ed. 3: 84, fig. 25, sub 2 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 41, fig. 169 (ven.); 1919.

General coloration gray, the praescutum with three dark brown stripes. Antennae black throughout. Wings with a pale brown tinge, stigma but slightly darker; *Rs* short, strongly angulated. Abdomen brownish gray, including hypopygium. Male hypopygium (Fig. 41, K): interbase a slender flattened blade, the tip acute; inner margin before midlength with several setulae. ♂. L. 5.5-6.5 mm.; w. 6.5-8 mm. ♀. L. 7.5-8.5 mm.; w. 7.5-8 mm.

(Apr., early May) N. H., Mass., southw. to Va.

Subgenus **Dicranota** Zetterstedt.

The typical subgenus (type, *guerini* Zetterstedt) includes four local species.

Key to Species
(Based chiefly on male characters)

1. Antennae (♂) short, if bent backwards not or scarcely reaching wing-root; flagellar segments short-oval 2
   Antennae (♂) elongate, if bent backwards extending approximately to base of second abdominal segment; flagellar segments long-oval, their ventral face slightly produced .... **notmani**
2. Male hypopygium without evident interbasal processes; phallosome subtended on either side by a flattened spinous blade; lateral angles of phallosome directed caudad (Fig. 41, M) .... **noveboracensis**
   Male hypopygium with the interbasal process a long slender, nearly straight rod; phallosome a quadrate plate, the outer lateral angles produced laterad into divaricate yellow horns 3
3. Male hypopygium with caudal horns of phallosome appearing as short triangular yellow blades; interbase subacute at apex (Fig. 41, J) .... **currani**
   Male hypopygium with the caudal horns of phallosome long and slender, not triangular in outline; interbase obtusely rounded at apex (Fig. 41, L) **divaricata**

Dicranota (*Dicranota*) **currani** Alex. (Fig. 41, J).
1926. *Dicranota currani* Alexander; Ent. News, 37: 50.

Mesonotal praescutum yellowish gray, with three very conspicuous dark brown stripes, the broad median stripe entire except near suture. Legs brownish black, femoral bases restrictedly paler. Wings weakly tinged, the stigma pale brown. Male hypopygium (Fig. 41, J). ♂. L. about 5 mm.; w. 7-7.5 mm.

(May) Ont., Que., westw. to Minn.

D. (*Dicranota*) **divaricata** Alex. (Fig. 41, L).
1925. *Dicranota divaricata* Alexander; Ent. News, 36: 203-204.

Closely allied to *currani*. Median praescutal stripe more evidently divided, to produce two intermediate brown stripes. Abdominal tergites light brown, the extreme caudal margins of intermediate ter-

gites narrowly light yellow. Male hypopygium (Fig. 41, L). ♂. L. 4.5-5 mm.; w. 6.3-7 mm.

(March) N. C.

D. (*Dicranota*) **notmani** sp. nov.
1929. *Dicranota currani* Alexander: Bull. Brooklyn Ent. Soc., 24:23 (erroneous record).

Very closely allied and generally similar to *currani*, differing especially in the elongate antennae of male, which, if bent backward, would reach about to base of second abdominal segment; flagellar segments long-oval, slightly produced on ventral face; terminal segment much reduced in size. Median praescutal stripe nearly entire, vaguely divided on more than anterior half by a pale vitta. Male hypopygium about intermediate in structure between that of *currani* and *divaricata*, the caudo-lateral angles of phallosome being more slender than in former but stouter than in latter. Interbase pointed at tip, as in *currani*.

Holotype, ♂, Keene Valley, Essex Co., N. Y., May 26, 1920 (H. Notman); in author's collection.

Named in honor of the collector, Mr. Howard Notman, to whom I am indebted for many Tipulidae from the Adirondack Mountains.

D. (*Dicranota*) **noveboracensis** Alex. (Fig. 41, M).
1914. *Dicranota noveboracensis* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 600.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 19, fig. 1 (ven.); 1908 (as *rivularis*). Alexander, Cfls. N. Y., 1, pl. 41, fig. 168 (wing); 1919.

General coloration gray, the praescutum with three dark brown stripes, the median one faintly divided by a pale line. Halteres pale. Wings gray, stigma pale brown; cell R_3 sessile to relatively long-petiolate. Abdomen brown, sparsely pruinose. Male hypopygium (Fig. 41, M). ♂. L. 5.5-6.5 mm.; w. 6.5-7.5 mm. ♀. L. 6-6.5 mm.; w. 7.5-8 mm.

(May) Que., Mass., N. Y. Reported erroneously from Wisconsin by Dickinson.

Subgenus **Amalopina** Brunetti

1912. *Amalopina* Brunetti; Fauna Brit. India, Dipt. Nematocera, p. 517.
1916. *Rhaphidolabina* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 540-541.

The subgenus includes a single species in the New World, with a few others in Eastern Asia. The choice of the name *Amalopina* by Brunetti was unfortunate, since it is the exact form earlier used for the entire section or tribe by Osten Sacken and others. The antennae are 15-segmented, with relatively long verticils; the wings have cell R_3 long-petiolate and vein R_2 slightly oblique in position. The adults of our local fly are common along shaded streams and in wet marshy places in woods. The larvae live in wet earth.

Dicranota (*Amalopina*) **flaveola** (O. S.) (Figs. 40, G; 42, A).
1869. *Rhaphidolabis flaveola* Osten Sacken; Mon. Dipt. N. Amer., 4:288.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 25, fig. 3 (ven.); 1908 (as *Amalopis*, sp. ?). Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 54 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 41, fig. 170 (ven.); 1919.

General coloration pale yellow to whitish yellow, unmarked. Halteres and legs pale yellow. Wings (Fig. 40, G) pale yellow, iridescent, the veins brown, distinct. Abdomen yellow, the terminal segments weakly darkened. Male hypopygium (Fig. 42, A). ♂. L. 5-5.5 mm.; w. 5-7 mm. ♀. L. 6-7 mm.; w. 6.5-8 mm.

(Late May, Sept.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to Md. and N. C.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Hartland, June 8-9, 1929 (C. P. A.); Kent Falls, May 31, 1931, June 12-13, 1931, Aug. 19, 1931 (C. P. A.); Norfolk, June 9, 1929, July 24, 1931, Sept. 11, 1928 (C. P. A.); Salisbury, Sept. 5-12, 1928 (G. C. C.); Saptree Run State Park, June 14, 1933 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

Subgenus **Plectromyia** Osten Sacken

1865. *Astrolabis* Osten Sacken; Proc. Ent. Soc. Philadelphia, 4:225 (nom. nud.).
1869. *Plectromyia* Osten Sacken; Mon. Dipt. N. Amer., 4:282-284.

Plectromyia is obviously nothing but a weak off-shoot of *Rhaphidolabis*. Antennae short in both sexes. The local species are chiefly northern in distribution. The adults are most frequently found along small mountain streams, while the early stages are quite unknown.

Key to Species
(Based chiefly on male characters)

1. Antennae 15-segmented; cell R_3 long-petiolate, R_{2+3+4} exceeding *m-cu*; male hypopygium with the median region of tergite produced into a Y-shaped structure that is densely set with stout setae (Fig. 42, D) .... **petiolata**
   Antennae 13-segmented; cell R_3 sessile to short-petiolate, R_{2+3+4}, when present, shorter than *m-cu*; male hypopygium with the median region of tergite broadly and obtusely rounded 2
2. Male hypopygium with the lateral tergal arms split at apex into two equal or nearly equal acute teeth; interbase with two short apical teeth, nearly equal in length but one more slender and obtuse (Fig. 42, B) .... **confusa**
   Male hypopygium with the lateral tergal arms broad, one apical lobe broadly rounded; interbase with the axial spine very elongate, the lateral spine small (Fig. 42, C) .... **modesta**

Dicranota (*Plectromyia*) **confusa** (Alex.) (Fig. 42, B).
1924. *Rhaphidolabis* (*Plectromyia*) *confusa* Alexander; Bull. Brooklyn Ent. Soc., 19:63.

Almost as in *modesta*, differing most evidently in details of the male hypopygium (Fig. 42, B). ♂. L. 4-4.5 mm.; w. 4.8-5.6 mm. ♀. L. about 5 mm.; w. 5.5-6 mm.

(May, June) Que., N. B., Vt., Mass. and N. Y., southw. to N. C. and S. C. (Low Canadian).

Connecticut.—Hartland, June 9, 1929 (C. P. A.).

D. (*Plectromyia*) **modesta** (O. S.) (Figs. 40, H; 42, C).
1869. *Plectromyia modesta* Osten Sacken; Mon. Dipt. N. Amer., 4:284.

Figs.—Osten Sacken, *Ibid.*, 4, pl. 2, fig. 18 (wing). Williston, Man. N. Amer. Dipt., Ed. 3:84, fig. 3 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 41, fig. 174 (ven.); 1919.

General coloration pale brown, with three slightly darker brown praescutal stripes. Antennae dark throughout. Knobs of halteres weakly infuscated. Wings nearly hyaline; stigma scarcely indicated; veins pale brown. Abdomen brown, the hypopygium a trifle more yellowish. Male hypopygium (Fig. 42, C). ♂. L. 4.2-5 mm.; w. 5.5-6 mm. ♀. L. about 5 mm.; w. 5-5.5 mm.

(June) N. H., Vt., in mountains. (High Canadian, Hudsonian).

D. (*Plectromyia*) **petiolata** (Alex.) (Fig. 42, D).
1919. *Tricyphona petiolata* Alexander; Can. Ent., 51:194-195.

(July, Aug.) Que., N. H. (Mt. Washington, 5000 feet and over), westw. to high mountains of Colo. (Hudsonian).

Subgenus **Rhaphidolabis** Osten Sacken

1869. *Rhaphidolabis* Osten Sacken; Mon. Dipt. N. Amer., 4:284-287.

A numerous group of small pediciine crane-flies that are most commonly found along streams and in boggy wooded areas. The early stages live in saturated earth. The adults are on the wing in Spring and Fall, and some, at least, have two generations per year.

Key to Species
(Based chiefly on male characters)

1. Cell R_3 of wings sessile or nearly so (Fig. 40, I); male hypopygium with the median region of tergite not or scarcely produced (in *rogersiana*, produced into a broad lobe with truncated apex) 2
   Cell R_3 of wings long-petiolate (Fig. 40, J); male hypopygium with the tergite produced medially into a slender lobe 4
2. Male hypopygium with median region of tergite merely rounded, the lateral arms appearing as paddle-like blades, with rounded tips; interbase short, bidentate at apex; wings subhyaline to pale grayish 3
   Male hypopygium with median region of tergite produced into a broad lobe, its apex truncate, the lateral arms small, each bent at apex into a simple point; interbase a long, nearly straight yellow rod, its apex microscopically toothed (Fig. 42, I); wings milky-white .... **rogersiana**
3. Coloration of thorax grayish brown, the praescutum with three dark brown stripes; abdomen dark brown, the caudal margins of segments paler; wings very pale brown, *Rs* short, arcuated to angulated; male hypopygium with interbase relatively narrow (Fig. 42, F) .... **cayuga**
   Coloration of thorax reddish brown, sparsely gray, pruinose, the praescutum with three indistinct darker stripes; abdomen yellowish brown, the hypopygium bright yellow; wings nearly hyaline, *Rs* somewhat elongated and gently arcuate; male hypopygium with the interbase broader (Fig. 42, J) **rubescens**
4. Thoracic pleura chiefly gray pruinose; male hypopygium with the basistyle bearing a conspicuous darkened hairy lobe on mesal face near base; inner dististyle somewhat bottle-shaped, broad basally, the outer half suddenly narrowed into a neck-like portion, the apex obtusely rounded (Fig. 42, H) 5

Thoracic pleura chiefly yellow, the ventral sternopleurite dark; male hypopygium without a lobe on mesal face of basistyle; inner dististyle elongate, more blade-like, gradually narrowed to a subacute tip (Fig. 42, K) 6

5. Male hypopygium with interbase a flattened blade that terminates in two slender arms directed toward one another, to appear more or less like tongs; lateral arms of tergite appearing as a long, slender, strongly curved hook (Fig. 42, G) .... **forceps**

Male hypopygium with interbase bearing two unequal arms, one a broadly flattened blade, the shorter arm slender, sinuous; lateral arm of tergite only gently curved at apex (Fig. 42, H) .... **persimilis**

6. Male hypopygium with interbase terminating in a slender spinous point, the structure somewhat resembling the head and beak of a bird; lateral arm of tergite only slightly curved at apex; apex of inner dististyle subacute (Fig. 42, E) .... **avis**

Male hypopygium with interbase a broadly flattened blade, the apex narrowed and obtusely rounded; lateral arm of tergite very strongly recurved into a hook; apex of inner dististyle more obtuse (Fig. 42, K) ...... **tenuipes**

Dicranota (*Rhaphidolabis*) **avis** (Alex.) (Fig. 42, E).
1926. *Rhaphidolabis* (*Rhaphidolabis*) *avis* Alexander: Ent. News, 37: 50, 51.

Closely allied to *tenuipes*, differing chiefly in the structure of the hypopygium, notably of the interbase (Fig. 42, E). Praescutal stripes broad. ♂. L. 5.5-5.8 mm.; w. 5.8-6.3 mm.

(Aug., Sept.) Mass. and Ct., southw. to Va. and N. C.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Kent Falls, Aug. 19, 1931 (C. P. A.).

D. (*Rhaphidolabis*) **cayuga** (Alex.) (Figs. 40, I; 42, F).
1916. *Rhaphidolabis* (*Rhaphidolabis*) *cayuga* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 543-544.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 13, fig. 1 (wing); 1908 (as *tenuipes*). Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 57 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 41, fig. 173 (wing); 1919.

Antennae dark brown. Head brownish gray. Knobs of halteres dark brown. Wings (Fig. 40, I) with stigma pale brown; cell R_3 shortly to broadly sessile. Male hypopygium (Fig. 42, F) brownish yellow. ♂. L. 5-5.5 mm.; w. 5.5-6.5 mm. ♀. L. 6.5-7 mm.; w. 7.5 mm.

(May, June; Aug., Sept.) Que., Me., N. H., N. Y., Pa., westw. to Mich., southw. to S. C.

Connecticut.—Norfolk, May 16, 1931, Sept. 12, 1928 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.).

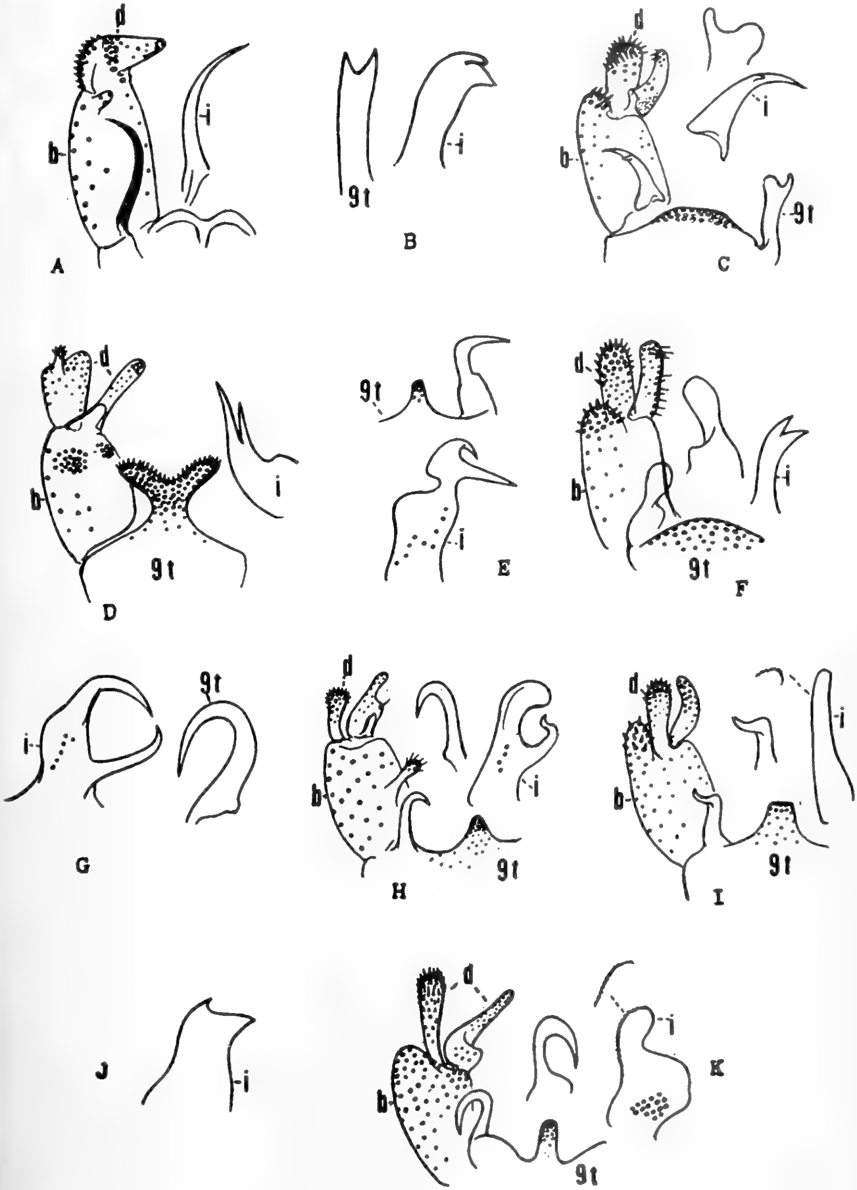
D. (*Rhaphidolabis*) **forceps** (Alex.) (Fig. 42, G).
1924. *Rhaphidolabis* (*Rhaphidolabis*) *forceps* Alexander: Bull. Brooklyn Ent. Soc., 19: 63, 64.

General coloration of thorax gray, the praescutum with three dark brown stripes. Antennae black throughout. Wings with a faint brown tinge, the stigma darker; *Rs* weakly angulated to strongly arcuated; basal section of R_5 very short to lacking. Abdomen dark brown. Male hypopygium (Fig. 42, G) much as in *persimilis*, differing es-

FIGURE 42. Pediciini; male hypopygia.

A. *Dicranota (Amalopina) flaveola* (O.S.)
B. *D. (Plectromyia) confusa* (Alex.)
C. *D. (P.) modesta* (O.S.)
D. *D. (P.) petiolata* (Alex.)
E. *D. (Rhaphidolabis) avis* (Alex.)
F. *D. (R.) cayuga* (Alex.)
G. *D. (R.) forceps* (Alex.)
H. *D. (R.) persimilis* (Alex.)
I. *D. (R.) rogersiana* (Alex.)
J. *D. (R.) rubescens* (Alex.)
K. *D. (R.) tenuipes* (O.S.)

Symbols: *b,* basistyle; *d,* dististyle; *i,* interbase; *t,* tergite.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pecially in the shape of the interbase. ♂. L. about 4.5-5.5 mm.; w. 5-6.8 mm. ♂. L. 5.5-6 mm.; w. 7-7.5 mm.

(June) Que., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to Tenn.

Connecticut.—Hartland, June 9, 1929 (C. P. A.).

D. (*Rhaphidolabis*) **persimilis** (Alex.) (Fig. 42, H)
1920. *Rhaphidolabis persimilis* Alexander; Can. Ent., 52: 79-80.

General coloration of thorax, including pleura, gray; praescutal stripes distinct. Male hypopygium (Fig. 42, H). ♂. L. 4-4.5 mm.; w. 4.8-5.5 mm.

(Apr., May; Oct.) Md., Va., N. C., S. C. (Transition).

D. (*Rhaphidolabis*) **rogersiana** (Alex.) (Fig. 42, I).
1925. *Rhaphidolabis* (*Rhaphidolabis*) *rogersiana* Alexander; Ent. News, 36: 204.

General coloration of thorax gray, the praescutum with three still darker leaden-gray stripes; wings tinged with milky white, stigma pale brown; cell R_3 sessile or very short-petiolate. Male hypopygium (Fig. 42, I). ♂. L. 5.2-5.5 mm.; w. 6-6.5 mm. ♀. L. 6-6.5 mm.; w. 7-7.5 mm.

(June-Aug.) Que., westw. to Mich. (Hudsonian, high Canadian).

D. (*Rhaphidolabis*) **rubescens** (Alex.) (Fig. 42, J).
1916. *Rhaphidolabis* (*Rhaphidolabis*) *rubescens* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 544-545.

Figs.—Alexander, *Ibid.*, 1916, pl. 28, fig. 58 (wing). Alexander, Cfls. N. Y., 1, pl. 41, fig. 172 (wing); 1919.

Closely allied to *cayuga*. Head light silvery gray. Wings with stigma very pale to indistinct. Abdomen with hypopygium (Fig. 42, J): interbase with teeth more unequal than in *cayuga*. ♂. L. 5-5.5 mm.; w. 6-6.6 mm. ♀. L. 6-6.5 mm.; w. 7-7.5 mm.

(June; Aug.) N. B., Me., N. H., Vt., Mass., N. Y.

D. (*Rhaphidolabis*) **tenuipes** (O. S.) (Figs. 40, J; 42, K).
1869. *Rhaphidolabis tenuipes* Osten Sacken; Mon. Dipt. N. Amer., 4: 287.

Figs.—Osten Sacken, *Ibid.*, pl. 2, fig. 17 (wing). Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 19, fig. 2 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3: 84, fig. 25, sub 14 (ven.); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 28, fig. 56 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 41, fig. 171 (wing); 1919.

Thorax chiefly yellowish, the praescutum almost covered by three more or less confluent brown stripes. Head brown, the orbits light gray. Wings (Fig. 40, J) tinged with grayish, stigma slightly darker. Abdomen brown, the terminal segments darker. Male hypopygium (Fig. 42, K). ♂. L. 6.5-7 mm.; w. 6-7 mm. ♀. L. about 7 mm.; w. 7-7.5 mm.

(June; Aug., Sept.) Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to Md.

Connecticut.—E. Hartland, Sept. 11, 1928 (C. P. A.); Norfolk, Sept. 6, 1928 (G. C. C.); W. Granby, Sept. 11, 1928 (C. P. A.).

Hexatomini

In the local fauna, the tribe Hexatomini includes eight subtribes that are readily told from all other Limoniinae, with the exception of the Pediciini, by the presence of spurs on the tibiae. All but two of these subtribes, the Atarbaria and the Elephantomyaria, are further separated from the Limoniini and aberrant Eriopterini (*Toxorhina*; *Gonomyia*; *Teucholabis*) by the presence of three branches of *Rs* reaching the wing-margin. Many of the included genera have cell M_1 of the wings present, a character found in but two of the regional genera of Eriopterini (*Cladura*, *Neolimnophila*). The diverse habits of the adults and larvae of the various subtribes are indicated under the various groups.

After this manuscript was completed, a surprising addition to the tipulid fauna of eastern North America was made by the discovery in the White Mountains, New Hampshire, of *Phyllolabis laggänensis* Alexander, previously known only from Alberta. The genus *Phyllolabis* runs to couplet 10 by the use of the accompanying key to the hexatomine genera. It is readily told from all others in our fauna by the loss of vein R_2 and the position of *m-cu* close to the extreme outer end of cell *1st* M_2, the latter character being much as in the family Trichoceridae. The species, *lagganensis*, is of medium size, dark-colored, with unmarked wings. The specimens were secured in late August, 1935, at high altitudes on Mount Madison. (Occas. Pap. Boston Soc. Nat. Hist., 8:275-276, fig. 3; 1936).

Key to Subtribes and Genera

1. Antennae with not more than 12 segments (Hexatomaria) .... **Hexatoma** 415
   Antennae with more than 13 segments 2
2. Rostrum elongate, exceeding one-half the length of the entire body (Fig. 46, L) (Elephantomyaria) .... **Elephantomyia**
   Rostrum short, or of moderate length only, not exceeding in length the remainder of head 3
3. Wings with two branches of *Rs* reaching the margin (Fig. 44, O) (Atarbaria) .... **Atarba**
   Wings with three branches of *Rs* reaching the margin (Fig. 44, A-E, L, N) 4
4. Apical cells of wing with macrotrichia (Figs. 43, A, B, J, K; 44, I) 5
   Cells of wings without macrotrichia (excepting in stigmal area) 7
5. Cell R_3 of wing (Fig. 44, I) sessile or subsessile; in local species, cell M_1 lacking and the macrotrichia involving cells basad of cord .... **Ulomorpha**
   Cell R_3 of wings petiolate; cell M_1 present, rarely lacking, in the latter case (*Oxydiscus cayuga,* Fig. 43, B; *Limnophila subtenuicornis,* Fig. 43, K) with macrotrichia confined to extreme apical cells of wing 6
6. Small species (wing less than 5.5 mm.); antennae short in both sexes (Oxydiscaria) (Fig. 43, A, B) .... **Oxydiscus**
   Larger species (wing over 6 mm.); antennae of male elongate (Limnophilaria, part) (Fig. 43, J, K) .... **Limnophila: Lasiomastix**
7. A supernumerary crossvein in cell *C* (Fig. 43, C) (Epiphragmaria) **Epiphragma** 368
   No supernumerary crossvein in cell *C* 8

8. Wings with *m-cu* at or close to fork of M; anterior arculus lacking (Fig. 43, D) (Dactylolabaria) .... **Dactylolabis**
   Wings with *m-cu* beyond the fork of M, at from one-third to one-half the length of the cell *1st* M_2; where close to fork of M (some *Pseudolimnophila*), the arculus complete 9
9. Wings with the anterior arculus lacking (Fig. 43, E-G) (Pseudolimnophilaria, part) 10
   Wings with the anterior arculus present (Fig. 43, H-P) 11
10. Cell *1st* M_2 of wings very large, its inner end lying far proximad of the other elements of the cord (Fig. 43, E) .... **Prolimnophila**
    Cell *1st* M_2 of wings of normal size, its inner end straight and in approximate alignment with the elements of the anterior cord (Fig. 43, F, G) **Austrolimnophila**
11. Wings with Sc relatively short, Sc_1 ending before the level of the fork of Rs (Fig. 44, F-H) (Limnophilaria, part); compare also *Limnophila albipes*, Fig. 44, C, readily separated by the white posterior tarsi 12
    Wings with Sc longer, Sc_1 ending opposite or beyond the level of the fork of Rs (Figs. 43, H, I; 44, D, E); compare also *Pilaria recondita*, distinguished by the elongate antennal verticils 13
12. Antennae with long, conspicuous verticils; tuberculate pits present, small, placed at extreme cephalic end of praescutum; Rs elongate, exceeding vein R_3; cell M_1 present or lacking (Fig. 44, G, H) .... **Pilaria**
    Antennae with short verticils; tuberculate pits lacking; Rs short and strongly arcuated or angulated at origin; cell M_1 lacking (Fig. 44, F) **Shannonomyia**
13. Head strongly narrowed and prolonged behind; radial and medial veins beyond cord long and sinuous; vein R_3 extending generally parallel to vein R_4, not diverging markedly at tips; vein *2nd A* strongly curved to margin (Fig. 43, H, I). (Pseudolimnophilaria, part)............ **Pseudolimnophila** 374
    Head broad, not conspicuously narrowed behind; radial and medial veins more nearly straight; vein R_3 diverging strongly from vein R_4; cell R_3 conspicuously widened at margin; vein *2nd A* not curved strongly into margin (Fig. 44, A-C). (Limnophilaria, part) .... **Limnophila** 379

1. Subtribe Oxydiscaria

Oxydiscus de Meijere

1891. *Adelphomyia* of authorities, *nec* Bergroth, Mittheil. Naturf. Ges. Bern, 1890:134.
1913. *Oxydiscus* de Meijere; Tijd. voor Ent., 56:350.

The genus *Oxydiscus* is placed in the present tribe with some question. On the basis of structure of the adult, the species of the genus are hexatomine and are the smallest species of the tribe within our faunal limits. The larvae of this genus show certain features held as being characteristic of the tribe Pediciini and the group had earlier been placed in this latter tribe in treatments by the present writer. The immature stages occur in rich saturated organic earth.

Key to Species

1. Wings with cell M_1 lacking (Fig. 43, B) .... **cayuga**
   Wings with cell M_1 present (Fig. 43, A) 2
2. Coloration of body and wings clear light yellow; macrotrichia of wing-cells very restricted in number and area, occurring in the extreme outer cells only **minutus**
   Coloration of thoracic notum brownish yellow to dark brown; wings tinged with gray or brown; macrotrichia of wing-cells more abundant, occurring in cells distad of level of vein R_2 3

3. Thoracic pleura clear yellow, unmarked .... **americanus**
   Thoracic pleura yellow, with two narrow brown longitudinal stripes that are best delimited in front .... **pleuralis**

Oxydiscus americanus (Alex.) (Fig. 43, A).
1912. *Adelphomyia americana* Alexander: Pomona Coll. Journ. Ent., 4:829-831.

Figs.—Alexander, *Ibid.*, fig. 260, A (ven.). Alexander, Ent. News, 22:353, fig. 4 (wing, as *senilis*); 1911. Alexander, Cfls. N. Y., 1, pl. 41, fig. 160 (ven.); 1919.

Vein R_2 present (Fig. 43, A). ♂. L. about 3-3.5 mm.; w. 4.2-4.6 mm. ♀. L. about 4 mm.; w. 5-5.5 mm.

(Aug., Sept.) N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to N. C. and S. C.

Connecticut.—Norfolk, June 6-12, 1928 (C. P. A., G. C. C.); Salisbury, Sept. 5-12, 1928 (C. P. A., G. C. C.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

O. cayuga (Alex.) (Fig. 43, B).
1912. *Adelphomyia cayuga* Alexander: Pomona Coll. Journ. Ent., 4:831.
1916. *Ormosia abnormis* Dietz: Trans. Amer. Ent. Soc., 42:137-138.
1921. *Adelphomyia hazletonensis* Dietz: *Ibid.*, 47:252-253.

Figs.—Alexander, *Ibid.*, fig. 260, B (wing). Alexander, Cfls. N. Y., 1, pl. 41, fig. 162 (ven.); 1919. Dietz, Trans. Amer. Ent. Soc., 42, pl. 10, fig. 3 (hyp.); 1916.

General coloration brown to dark brown, the pleura darkened, somewhat paler behind. Vein R_2 usually faint and indistinct; macrotrichia of cells relatively numerous beyond level of outer end of cell *1st* M_2 (Fig. 43, B). ♂. L. 3-3.5 mm.; w. 4-5 mm. ♀. L. 4.5-5 mm.; w. 4.5-5 mm.

(Aug., Sept.) Me., N. H., Vt., Mass., N. Y., Pa., westw. to Ind. and Mich.

O. minutus (Alex.)
1911. *Adelphomyia minuta* Alexander: Can. Ent., 43:287-288.

Figs.—Alexander, Cfls. N. Y., 1, pl. 41, fig. 161 (ven.); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, fig. 24 (thorax); 1925.

Wings with vein R_2 distinct. ♂. L. about 3.3-4.4 mm.; w. 4-4.2 mm. ♀. L. 4.5-5 mm.; w. 4.5-4.8 mm.

(Late May, June) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich., southw. to N. C .

Connecticut.—Cornwall Bridge, May 30, 1931 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 30-31, 1931 (C. P. A.); Norfolk, May 30, 1931, June 12, 1931, June 9, 1929 (C. P. A.); Union, June 14, 1933 (C. P. A.).

O. pleuralis (Dtz.)
1921. *Adelphomyia pleuralis* Dietz: Trans. Amer. Ent. Soc., 47:251-252.

Antennae brown, the pedicel dark brown. Abdomen light brown, the subterminal segments dark brown. ♂. L. about 2.5-2.8 mm.; w. 3.3-3.6 mm. ♀. L. 3.3-3.8 mm.; w. 3.8-4.2 mm.

(June-Aug.) Ont., N. H., Mass., Ct., N. Y., Pa., westw. to Ind. and Mich., southw. to S. C., Tenn. and Fla.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Kent Falls, Aug. 19, 1931 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P.A.); Stafford Springs, June 14, 1933 (C.P. A.); Union, June 14, 1933 (C. P. A.).

2. Subtribe Epiphragmaria

Epiphragma Osten Sacken

1859. *Limnophila (Epiphragma)* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859:238.

The genus *Epiphragma* includes two of our most striking and beautiful species among the medium-sized Tipulidae. The immature stages are spent in moist decaying wood, while the adult flies may be swept from rank vegetation in shaded places, or appear at dusk in small dancing swarms. Elsewhere in the World, this genus and its close ally in the Southern Hemisphere, *Austrolimnophila* Alexander, are represented by a host of unusually handsome crane-flies.

Key to Species

1. Wings with pale brown crossbands that are narrowly margined with darker brown, these darkened areas separated by the pale ground-color; a brown ring at tip of each femur (Fig. 43, C) .... **fascipennis**
   Wings with an irregular pattern of brown and tawny on a subhyaline ground, all darkened areas being more or less confluent on the anterior half of wing; a brown ring before tip of each femur .... **solatrix**

Epiphragma fascipennis (Say) (Figs. 22, C; 43, C).

1823. *Limnobia fascipennis* Say: Journ. Acad. Nat. Sci. Philadelphia, 3:19.

1859. *Limnophila (Epiphragma) pavonina* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859:239.

Figs.—Snodgrass, Journ. N. Y. Ent. Soc., 11, pl. 11, fig. 18 (ovipos.); 1903. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 9, figs. 13, 15 (hyp.); 1904. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 19, fig. 3 (ven.); pl. 31 (entire insect); 1908. Alexander, Cfls. N. Y., 1, pl. 41, fig. 158 (wing); 1919. Dickinson, Cfls. Wisc., p. 200, fig. 91 (wing); 1932.

General coloration yellowish brown, pruinose; mesonotal praescutum margined in front with chestnut-brown. Femora, in cases, with a second, subterminal brown ring. Male hypopygium (Fig. 22, C). ♂. L. 9-11 mm.; w. 9-12 mm. ♀. L. 10-12 mm.; w. 11-12 mm.

(May-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., R. I., N. Y., westw. to Alta., southw. to Ga., Fla. and La.

Connecticut.—Branford, June 13, 1918 (B. H. W.); Cornwall Bridge, May 30, 1931 (C. P. A.); Danbury, June 15, 1909 (C. W. J.); Eastford, June 12, 1919 (B. H. W.); Hamden, June 2, 1928 (R. B. F.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 30-31, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); New Haven, June 8, 1929 (W. E. B.); Norfolk, June 9, 1929, May 31, 1931, June 12, 1931 (C. P. A.); N. Branford, July 4, 1924 (R. B. F.); Orange, June 19, 1924 (B. H. W.); Riverton, May 30-31, 1931, June 8, 1929 (C. P.A.); Rowayton, June 10, 1909 (C. W. J.); Saptree Run State Park, June 14, 1933 (C. P. A.); Storrs, May 1933 (C.

S. C.); Tyler Lake, June 13, 1931 (C. P. A.); Waterbury, June 9, 1905 (W. E. B.); W. Hartford, June 10, 1929 (R. B. F.); Westford, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); Willington, June 24, 1932 (N. T.); Winsted, June 10, 1928 (R. B. F.).

E. solatrix (O. S.)

1859. *Limnophila (Epiphragma) solatrix* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 238.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 8 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 41, fig. 159 (wing); 1919.

General coloration brown, whitish pruinose, the mesonotal praescutum more reddish brown in front. ♂. L. 8-10 mm.; w. 8-11 mm. ♀. L. about 10 mm.; w. 11-12 mm.

(May-Aug.) N. Y. (Long Island), Md. and Va., westw. to Tenn., Ind. and Mo., southw. to Fla. and La.

3. Subtribe Dactylolabaria

Dactylolabis Osten Sacken

1859. *Dactylolabis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 240.

The genus *Dactylolabis* belongs to the more generalized Hexatomini, having the anterior arculus lacking. The various species are eminently lithophilous, frequenting the vertical faces of shaded cliffs and rock exposures. The larvae live in algal growth amid percolating water in these situations, while the adult flies are to be found resting on the walls and in crannies of the rock surface. Of the local species, the adult flies of *cubitalis* and *hudsonica* are less restricted to the lithophilous habitat, being more commonly swept from rank vegetation in ravines and gorges.

Key to Species

1. Wings unmarked, except for the vaguely defined stigma .... **cubitalis**
   Wings yellowish subhyaline, with a heavy spotted brownish gray pattern, this including clouds beyond the arculus, at origin of *Rs*, fork of *Sc*, along cord and outer end of cell *1st* M_2, fork of R_{2+3+4}, the stigma and fork of M_{1+2} 2
2. Wings tending to be degenerate, more or less reduced in size; costal fringe and scanty trichia of veins reduced to short spinous bristles; Arctic species .... **rhicnoptiloides**
   Wings of normal size; costal fringe and abundant trichia of veins long and hair-like; not Arctic species 3
3. A supernumerary crossvein in cell R_3, lying opposite or just proximad of R_2 **supernumeraria**
   No supernumerary crossveins in any cells of wing 4
4. Femora dark brown, the tips not paler; mesonotal praescutum yellowish gray, with four clearly delimited dark brown stripes (Fig. 43, D) .... **montana**
   Femora brown, the extreme tips paling to yellowish; mesonotal praescutum yellowish pollinose, the stripes darker but ill-defined, especially the laterals **hudsonica**

Following the completion of the present report, a remarkable new species of *Dactylolabis* (*pemetica* Alexander) was discovered on Mount Desert, Maine (June 1935), and later at high altitudes on

Mount Washington, New Hampshire (August 1935), on Mount Marcy, N. Y. (July 1938) and at high altitudes in the vicinity of Mt. Mitchell, N. C. The fly has unpatterned wings, much as in *cubitalis*, to where it would run by the use of the above key. The species differs conspicuously in the dark brown mesonotum, without distinct praescutal stripes, and especially in a noteworthy sexual dimorphism that involves the shape and venation of the wings. The stigmal region in the male sex is very large and hairy, distorting the venation of the anterior radial field, the anterior branch of the sector being chiefly atrophied. The venation of the female sex is normal for the genus. (Occas. Pap. Boston Soc. Nat. Hist., 8:288-291, figs. 1, 2; 1936).

Dactylolabis cubitalis (O. S.)
1869. *Limnophila cubitalis* Osten Sacken: Mon. Dipt. N. Amer., 4:229.

Figs.—Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 9, fig. 14 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 40, fig. 147 (wing); 1920.

General coloration gray, the brown praescutal stripes narrow and relatively inconspicuous. Femora yellow to brownish yellow, the outer segments of the legs darker, especially the tarsi. Wings with a strong yellowish suffusion, the stigma only slightly darker; *m-cu* at or close to fork of *M*. ♂. L. 8-8.5 mm.; w. 9-10.5 mm. ♀. L. 9-10 mm.; w. 10-11 mm.

(May, June) N. Y. and Ohio, westw. to Ind. and Wisc., southw. to Va. and N. C.

D. hudsonica Alex.
1931. *Dactylolabis hudsonica* Alexander: Bull. Brooklyn Ent. Soc., 26:181-182.

Wings with *m-cu* beyond the fork of *M*, in most cases the distance exceeding one-half the crossvein. Male hypopygium with the basistyles dark brown. ♂. L. about 6.5 mm.; w. 8-8.5 mm. ♀. L. about 6.5-7 mm.; w. 7.5-8 mm.

(Late May-early July) Que., Me., N. H., Mass., southw. to N. C. and Tenn. (Hudsonian, Canadian, Transitional).

D. montana (O. S.) (Fig. 43, D).
1859. *Limnophila* (*Dactylolabis*) *montana* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:240.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 7 (ven.), pl. 4, figs. 26, 26a (hyp.); 1869. Needham, 23rd Rept. N. Y. State Ent. for 1907, pl. 13, fig. 2 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 40, fig. 148 (ven.); 1919.

General coloration gray, with a sparse pollen, the four praescutal stripes dark brown, very conspicuous. Male hypopygium with the basistyles conspicuously pale. ♂. L. 6-9 mm.; w. 8-12 mm. ♀. L. 7-8 mm.; w. 7-10 mm.

The commonest and one of the most widely distributed of the local species of the genus. It varies very greatly in size but only a single species seems to be involved. On rocky cliffs along the south

shore of Gaspé, eastern Quebec, exceptionally large specimens were found (the largest measurements given).

(May-July) Ont., Que., N. B., Me., N. H., Vt., Mass., westw. to Ind. and Ill., southw. to S. C.

Connecticut.—Kent Falls, May 30-31, June 12-13, 1931 (C. P. A.).

D. rhicnoptiloides (Alex.)
1919. *Limnophila* (*Dactylolabis*) *rhicnoptiloides* Alexander: Canadian Arctic Exped. 1913-18, Rept. 3, C: 6c.

Fig.—Alexander, *Ibid.*, pl. 1, fig. 3 (wing).

General coloration black, dusted with gray. Wings long and narrow, tending to be atrophied, especially in width; posterior marginal fringe short; *Rs* spurred at origin. ♂. L. 8-9 mm.; w. 8-10 mm.

(Aug.) Arctic North America: Ellesmereland, Lab., westw. to Canad. N. W. Terr. (Arctic, Hudsonian).

D. supernumeraria Alex.
1929. *Dactylolabis supernumeraria* Alexander; Ent. News, 40: 46.

Generally similar to *montana*, differing especially in the details of coloration and venation. Mesonotal praescutum dark brownish gray, the slightly darker brown stripes poorly defined. Wings with cell *1st* M_2 large, exceeding vein M_3 beyond it. ♂. L. 7-8 mm.; w. 8-9 mm. ♀. L. about 8 mm.; w. 8.5-9 mm.

(June, July) N. B., Me., N. H., Vt., Mass., N. Y.

The presence of the supernumerary crossvein in cell R_3 is fairly constant, though individuals are occasionally found with this present in one wing and lacking in the other.

4. Subtribe Pseudolimnophilaria

Prolimnophila Alexander

1929. *Limnophila* (*Prolimnophila*) Alexander: Bull. Brooklyn Ent. Soc., 24: 187.

The only species of *Prolimnophila* is *P. areolata* (O. S.), a medium-sized yellow crane-fly that is common in cool, hemlock-yellow birch woodlands in June. The essential features of the genus lie in the broken arculus, in conjunction with the very large cell *1st* M_2, the inner end of which lies far proximad of the other elements of the cord. The early stages are unknown.

Prolimnophila areolata (O. S.) (Fig. 43, E).
1859. *Limnophila areolata* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 237.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 6 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 38, fig. 124 (ven.); 1919. Dickinson, Cfls. Wisc., p. 203, fig. 97 (ven.); 1932.

Head brownish yellow; antennae short in both sexes; verticils elongate, much exceeding the segments; head not strongly narrowed

behind. Mesonotum brownish yellow, without evident darker markings; tuberculate pits small, on extreme cephalic portion of praescutum; pseudosutural foveae pale and inconspicuous; pleura clearer yellow. Wings yellow, the stigma a trifle more brownish yellow; Sc_1 subequal to *m-cu*; *Rs* short, in alignment with, and approximately as long as, *Rs*; R_{2+3} angulated to subangulated at origin; *m-cu* beyond midlength of the cell. Abdominal tergites dark brown, the sternites and hypopygium more yellowish. ♂. L. 5.5-6.5 mm.; w. 7-8 mm. ♀. L. 5.5-6.5 mm.; w. 6.5-7.5 mm.

(May-July) Ont., Que., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ill. and Wisc., southw. to N. C. and Tenn.

Connecticut.—E. Hartland, June 8, 1929 (C. P. A.); Granby, June 8, 1929 (C. P. A.); Kent Falls, May 31, June 12-13, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norfolk, June 9, 1929, June 12, 1931 (C. P. A.); Phoenixville, June 14, 1933 (C. P. A.); Putnam, June 15, 1933 (C. P. A.); Riverton, June 12, 1931 (C. P. A.); Tunxis State Park, June 12, 1931 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.); Union, June 14, 1933 (C. P. A.).

Austrolimnophila Alexander

1920. *Austrolimnophila* Alexander; Arkiv för Zoologi, 13, nr. 6: 4-5.
1934. *Archilimnophila* Alexander, *in* Curran, Keys to The Families and Genera of North American Diptera, p. 40.

Antennae (♂) elongate (*unica* and allies) or short in both sexes (*toxoneura* and allies); verticils elongate, subequal to or exceeding the segments; head broad, not narrowed behind. No tuberculate pits; pseudosutural foveae small, marginal in position. Wings (Fig. 43, F, G) with the anterior arculus lacking; *Rs* short or of moderate length only, angulated at origin; R_2 short, subequal to R_{1+2}; R_{2+3+4} elongate, subequal to *Rs*, gently to strongly arcuated, subequal to the anterior branch of *Rs* (*unica* and allies) or shorter than this branch; *m-cu* beyond the fork of *M*, usually at or near midlength of cell *1st* M_2.

The adult flies rest with the wings outspread, a habit characteristic of generalized hexatomine crane-flies. The early stages of *unica* are found in decaying wood. Abundant species of *Austrolimnophila* are found in the temperate portions of Australia, New Zealand and South America, though only a few occur in the northern hemisphere.

Key to Species

1. Wings brownish yellow, unmarked except for the slightly darker stigma; R_{2+3+4} short and very strongly arcuated, approximately one-half the length of the anterior branch of *Rs*; antennae short in both sexes, if bent backward extending about to the root of the halteres; verticils longer than segments (Fig. 43, F) .... **toxoneura**
   Wings tinged with pale brownish, sparsely to more heavily marked with brown clouds, at least the anterior cord so clouded; R_{2+3+4} elongate, only gently arcuated, in most cases subequal to the anterior branch of *Rs*; antennae of male elongate, if bent backward extending to or beyond the second abdominal segment; verticils shorter than segments 2
2. Wings relatively narrow, the cells correspondingly narrowed, especially cell *1st* M_2 which is parallel-sided; *Rs* relatively elongate, much exceeding its anterior branch; macrotrichia almost lacking on main stem of *M*, restricted

to two or three at extreme outer end; male hypopygium with the outer dististyle narrow, terminating in a short curved black spine; inner dististyle extended into a long straight apical point (Fig. 45, A) .... **harperi**

Wings broad, cell *1st* M_2 correspondingly widened; *Rs* short, subequal to its anterior branch; long conspicuous macrotrichia on distal half of main stem of *M*; male hypopygium with the outer dististyle a flattened blade that is suddenly narrowed to a black, nearly straight point; inner dististyle bearing a blackened lateral branch at near midlength (Figs. 43, G; 45, B) ...... **unica**

Austrolimnophila harperi (Alex.) (Fig. 45, A).
1926. *Limnophila harperi* Alexander: Insec. Inscit. Menst., 14:23-24.

Mesonotal praescutum yellowish gray with three blackish stripes, the median area broad. Wings with a restricted darker brown pattern, including the stigma and clouds at origin of *Rs*, along cord and on outer end of cell *1st* M_2; *m-cu* at near midlength of cell *1st* M_2. Male hypopygium (Fig. 45, A). ♂. L. 7-8 mm.; w. 7.5-8.5 mm. ♀. L. 10-11 mm.; w. 9-10 mm.

(June) N. Y. (high mts.), westw. to Alta. (Hudsonian, high Canadian).

Resting on wet faces of vertical cliffs. The habits of the adults have been briefly described by the writer (Bull. Brooklyn Ent. Soc., 24:23; 1929).

A. toxoneura (O. S.) (Fig. 43, F).
1859. *Limnophila toxoneura* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859:236.

Figs.—Needham, 23rd Rept. N. Y. State Ent. for 1907, pl. 18, fig. 2 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 38, fig. 126 (ven.); 1919. Dickinson, Cfls. Wisc., p. 202, fig. 94 (wing); 1932.

Head light gray. Mesonotum brownish yellow, the praescutum with two slightly darker brown submedian stripes; lateral margin of praescutum sometimes slightly darkened; pseudosutural foveae pale; pleura yellow, usually with a more or less distinct darkening on the propleura and anepisternum. Wings (Fig. 43, F) with *Rs* short, strongly arcuated to angulated at origin; *m-cu* at near midlength of cell *1st* M_2; cell M_1 deep. Abdomen elongate, in male with hypopygium blackened. ♂. L. 6-7 mm.; w. 6.5-8 mm. ♀. L. 8-9 mm.; w. 9-11 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Wisc., southw. to Va. and Tenn.

Connecticut.—Brooklyn, June 15, 1933 (C. P. A.); E. Hartland, June 8, 1929 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); Norfolk, June 9, 1929, June 12, 1931 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Tunxis State Park, June 12, 1931 (C. P. A.); Union, June 23, 1932 (N. T.).

A. unica (O. S.) (Figs. 43, G; 45, B).
1869. *Limnophila unica* Osten Sacken: Mon. Dipt. N. Amer., 4:205-206.

Figs.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 114 (wing); 1919. Dickinson, Cfls. Wisc., p. 204, fig. 98 (wing); 1932.

Mesonotum dark brown, more or less pruinose, the median region of praescutum with a more or less distinct stripe of the ground-color; pleura pruinose. Wings (Fig. 43, G) with a very restricted darker pattern, most evident as a cloud on the anterior cord; macrotrichia of veins long and conspicuous; veins R_{1+2}, R_2 and R_{2+3} all short and subequal in length. Male hypopygium (Fig. 45, B). ♂. L. 7-9 mm.; w. 7-9.5 mm. ♀. L. 7.5-8 mm.; w. 9-10 mm.

(Late May-July; more rarely in Autumn) Que., N. B., Me., N. H., Mass., N. Y., west. to Wisc., southw. to D. C. (Hudsonian, Canadian).

Pseudolimnophila Alexander

1919. *Pseudolimnophila* Alexander; Cornell Univ. Agr. Expt. Sta. Mem. 25:917.

1920. *Pseudolimnophila* Alexander; *Ibid.*, Mem. 38:848-850.

The chief points of distinction between *Pseudolimnophila* and *Limnophila* have been indicated in the key to the genera of Hexatomini. The immature stages of the two groups provide stronger and more satisfactory characters for the separation of the subtribes. In the following treatment, *Pseudolimnophila toxoneura* has been removed from the present genus and placed in *Austrolimnophila*. The adult flies frequent a variety of ecological habitats that are indicated under the various species. The early stages are spent in saturated earth in the same general habitats frequented by the adult. Edwards (1938) has placed this group as a subgenus under *Limnophila* Macquart.

Key to Species

1. Cell M_1 lacking (Fig. 43, I) .... **noveboracensis**
   Cell M_1 present (Fig. 43, H) 2
2. Thoracic pleura pale, striped longitudinally with dark brown, the longest stripe being the more dorsal one .... **contempta**
   Thoracic pleura uniform light to dark gray 3
3. Wings yellowish, distinctly marked with pale brown at stigma and on the crossveins and deflections of longitudinal veins (Fig. 43, H) ...... **luteipennis**
   Wings gray or yellowish gray, unmarked except for the stigmal area 4
4. Size large (wing, ♂, over 7 mm.); mesonotal praescutum with a median brown stripe, the lateral stripes not or scarcely indicated .... **inornata**
   Size small (wing, ♂, under 6 mm.); mesonotal praescutum gray, with four narrow brown stripes, the lateral pair distinct...................... **australina**

Pseudolimnophila australina Alex.

1927. *Pseudolimnophila australina* Alexander; Journ. N. Y. Ent. Soc., 35:56-57.

Size small (wing, ♂, 4.5-5.5 mm.). Wings with R_{2+3+4} long and gently arcuated, from two to three times the length of the basal deflection of R_5. ♂. L. 4-4.5 mm.; w. 4.5-5.5 mm. ♀. L. about 6 mm.; w. 6-6.2 mm.

(July) Md., westw. to s. Ind. and Tenn., southw. to S. C., Fla. and Ala. (Austral).

P. contempta (O. S.)

1869. *Limnophila contempta* Osten Sacken: Mon. Dipt. N. Amer., 4: 218-219.

1914. *L. nigripleura* Alexander and Leonard: Proc. Acad. Nat. Sci. Philadelphia, 1914: 592-593.

Figs.—Alexander and Leonard, *Ibid.*, pl. 25, fig. 3 (wing). Alexander, Cfls. N. Y., 1, pl. 39, fig. 136 (wing); 1919.

Mesonotal praescutum light brown, with indications of four slightly darker brown stripes, best indicated behind; pseudosutural foveae pale brown. Wings yellowish gray, the stigma darker; in cases, with very pale brown clouds along the cord and outer end of cell *1st* M_2; R_{2+3+4} long and gently arcuated, exceeding twice the basal deflection of R_5. ♂. L. about 5-5.5 mm.; w. about 6-6.5 mm. ♀. L. about 6-6.5 mm.; w. 6.5-7 mm.

(June-Sept.) Ont., Que., N. B., Me., N. H., Vt., N. Y., westw. to Mich. and Mo., southw. to S. C., Ga., Tenn. and n. Fla. A common fly in ravines, on shaded springy hillsides, in open gorges and similar places.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Kent Falls, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); New Haven, Aug. 20, 1928 (G. B.); Saptree Run State Park, June 14, 1933 (C. P. A.).

P. inornata (O. S.) (Figs. 22, D; 23, D).

1869. *Limnophila inornata* Osten Sacken: Mon. Dipt. N. Amer., 4: 219-220.

Fig.—Alexander, Cfls. N. Y., 1, pl. 39, fig. 134 (ven.); 1919.

General coloration clear gray, the mesonotal praescutum darkened medially but without a more intense capillary median vitta, the lateral stripes obsolete or nearly so; pleura clear blue-gray; pseudosutural foveae black. Wings (Fig. 23, D) with a faint brownish tinge, unmarked except for the slightly darkened stigmal area; R_{2+3+4} variable in length, in cases only a little longer than the basal deflection of R_5, in other specimens exceeding twice this length. ♂. L. 7-8 mm.; w. 7.5-8 mm. ♀. L. about 8.5-9.5 mm.; w. 8-9 mm.

(May-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to Md. A very characteristic inhabitant of sphagnum bogs.

The record and figure by Dickinson (Cfls. Wisc., p. 201, fig. 93; 1932) pertains to some other crane-fly.

Connecticut.—Branford, Aug. 11, 1904 (H. L. V.); E. Haddam, May 31, 1923 (W. E. B.); Manitic Lake, June 8-9, 1929, preyed upon by a cordylurid fly (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Putnam, June 15, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Stamford, June 7, 1923 (B. T. R. L.); Storrs (C. S. C.); Union, June 24, 1932 (N. T.).

P. luteipennis (O. S.) (Fig. 43, H).

1859. *Limnophila luteipennis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 236.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 10 (wing), pl. 4, fig. 25 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 39, fig. 135 (wing); 1919. Dickinson, Cfls. Wisc., p. 201, fig. 92 (wing); 1932.

FIGURE 43. Hexatomini; venation.

A. *Oxydiscus americanus* (Alex.)

B. *O. cayuga* (Alex.)

C. *Epiphragma fascipennis* (Say)

D. *Dactylolabis montana* (O. S.)

E. *Prolimnophila areolata* (O. S.)

F. *Austrolimnophila toxoneura* (O. S.)

G. *A. unica* (O. S.)

H. *Pseudolimnophila luteipennis* (O. S.)

I. *P. noveboracensis* (Alex.)

J. *Limnophila* (*Lasiomastix*) *macrocera* (Say)

K. *L.* (*L.*) *subtenuicornis* Alex.

L. *L.* (*Dicranophragma*) *fuscovaria* O. S.

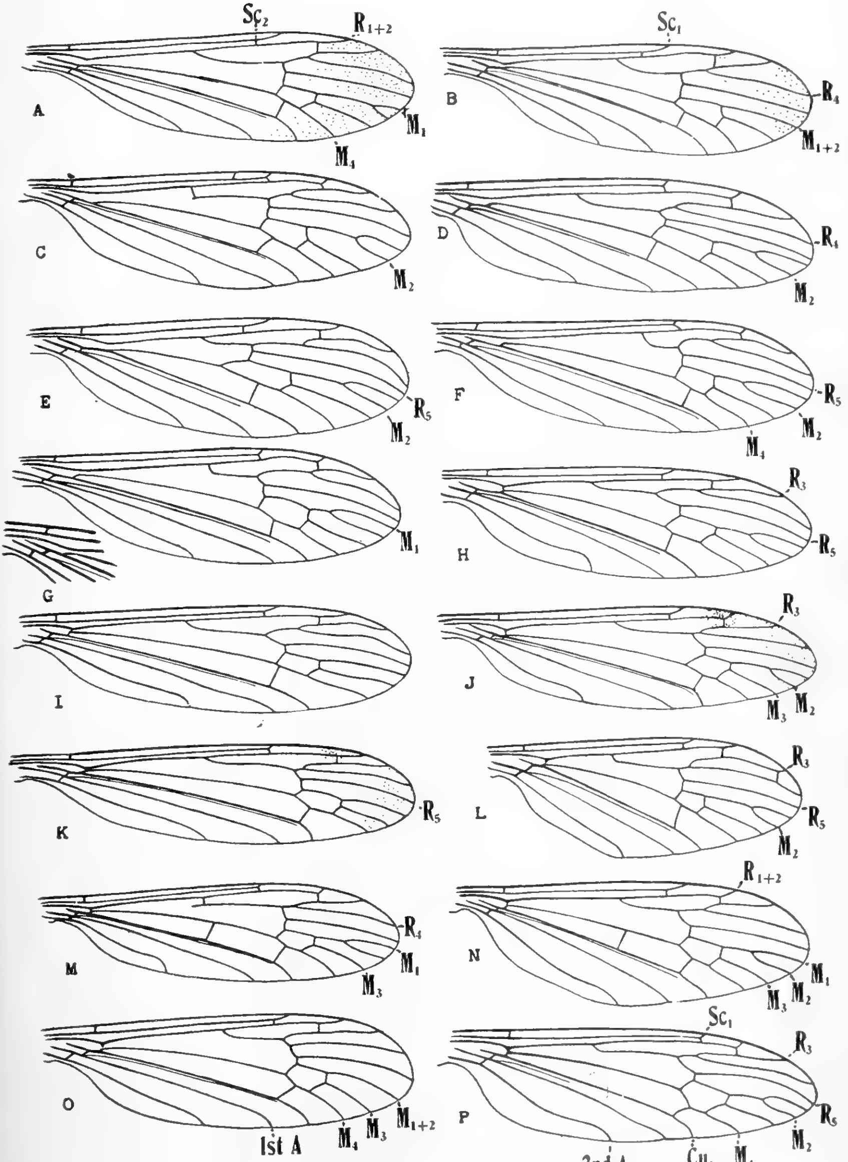
M. *L.* (*Idioptera*) *fasciolata* O. S.

N. *L.* (*Elaeophila*) *aprilina* O. S.

O. *L.* (*Idiolimnophila*) *emmelina* Alex.

P. *L.* (*Eutonia*) *alleni* Johns.

Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.


A
Sc_2
R_{1+2}
M_1
M_4
B
Sc_1
R_4
M_{1+2}
C
M_2
D
R_4
M_2
E
R_5
M_2
F
R_5
M_2
M_4
G
M_1
H
R_3
R_5
I
J
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M_3
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L
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M_2
M
R_4
M_1
M_3
N
R_{1+2}
M_1
M_3
M_2
O
M_{1+2}
M_3
M_4
1st A
P
Sc_1
R_3
R_5
M_2
M_4
Cu_1
2nd A

General coloration above gray to brownish gray, clearer gray laterally and on pleura; in most specimens with a capillary dark brown praescutal vitta. ♂. L. 7-7.5 mm.; w. 7.5-9 mm. ♀. L. 7.5-8 mm.; w. 8-8.5 mm.

(May-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Cal., southw. to Fla., Ala., Miss. and La. The most common member of the genus, especially characteristic of helophytic associations.

Connecticut.—East River, Sept. 1910 (Ely); Granby, June 8, 1929, Sept. 4, 1928 (C. P. A., G. C. C.); Manitic Lake, May 16, 1931, Aug. 6, 1929 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); Storrs (C. S.C.).

P. noveboracensis (Alex.) (Fig. 43, I).
1911. *Limnophila noveboracensis* Alexander; Psyche, 18: 196-198.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 3 (ven.). Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 18, fig. 6 (ven.); 1908 (as *quadrata*). Alexander, Cfls. N. Y., 1, pl. 40, fig. 150 (ven.); 1919. Dickinson, Cfls. Wisc., p. 202, fig. 95 (wing); 1932.

General coloration yellowish brown, the notum without distinct markings; pseudosutural foveae pale, inconspicuous; thoracic pleura yellowish. Wings with a pale yellowish tinge, the stigmal area a little darker; *m-cu* somewhat variable in position, often close to fork of M. ♂. L. 5.2-6 mm.; w. 6-6.5 mm. ♀. L. about 7-8 mm.; w. 7-7.8 mm.

(June-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Wisc., N. D. and Alta., southw. to N. C. and S. C. Especially characteristic of shaded humid woodlands near flowing water; occasionally in bogs.

Connecticut.—East River, July 4-Aug. 11, 1910 (Ely).

5. Subtribe Limnophilaria

Limnophila Macquart

1834. *Limnophila* Macquart; Suit. à Buffon, 1, Hist. Nat. Ins. Dipt.: 95.

Key to Subgenera

1. Apical cells of wing with scanty macrotrichia (Fig. 43, J, K) ..... **Lasiomastix**
   No macrotrichia in apical cells of wing 2
2. Supernumerary crossveins in either cell R_3 or cell M of wing 3
   No supernumerary crossveins in any cells of wing 5
3. A supernumerary crossvein in cell R_3 (Fig. 43, L) ..... **Dicranophragma**
   A supernumerary crossvein in cell M (Fig. 43, M, N) 4
4. Wings with an interrupted cross-banded pattern; Rs long-spurred at origin; antennae of male elongate (Fig. 43, M) ..... **Idioptera**
   Wings with a spotted pattern, or else immaculate; Rs slightly if at all spurred at origin; antennae short in both sexes (Fig. 43, N) ..... **Elaeophila**
5. Cell R_3 sessile; cell M_1 lacking (Fig. 43, O) ..... **Idiolimnophila**
   Cell R_3 petiolate; cell M_1 present 6
6. Very large species (wing over 16 mm.); wings with the branches of M leaving the main stem at a strong angle, cell *1st* M_2 thus being strongly hexagonal (Fig. 43, P) ..... **Eutonia**
   Smaller species (wing under 14 mm.); wings with the branches of M not strongly divergent, especially M_{3+4}, cell *1st* M_2 being more nearly rectangular in outline (Fig. 44, A) 7
7. Wings with R_{2+3+4} short, subequal to the basal deflection of R_5; Rs elongate, exceeding four times R_{2+3+4} (Fig. 44, A); coloration polished black (*mun-*

da, mundoides) or gray (*rufibasis* group), the latter group having the male hypopygium with a series of teeth on margin of outer dististyle, producing a comb-like appearance (Fig. 45, L, M) .... **Prionolabis**

Wings with R_{2+3+4} longer (Fig. 44, B, C, E), usually exceeding the basal deflection of R_5 (compare *irrorata*); *Rs* shorter, not exceeding three times R_{2+3+4} (compare *irrorata*); body-coloration never polished black; when gray, the male hypopygium without a comb of spines on the outer dististyle 8

8. *Rs* short, weakly to more strongly angulated at origin, more rarely merely arcuated (compare *lutea*); R_{2+3+4} subequal to or shorter than *m-cu* (Fig. 44, B); antennae short in both sexes .... **Phylidorea**

Rs longer, more gently arcuated; in species with *Rs* shorter (compare *poetica; laricicola; albipes, niveitarsis*) with antennae of male elongate, and, except in *poetica,* with R_{2+3+4} elongate, considerably exceeding *m-cu* **Limnophila**

The various subgenera of *Limnophila* are highly artificial and are chiefly maintained for convenience only. The exact definition of the limits of the subgenera *Prionolabis*, *Phylidorea*, and *Limnophila*, s. s., has proved especially difficult:

Prionolabis, as typified by *rufibasis*, has a very distinct structure of the male hypopygium, and the nearest allied species (*simplex*, *walleyi*) are not apt to be traced elsewhere. The two polished black species (*munda*, *mundoides*) have a very different hypopygial structure but in other features are referrable to *Prionolabis*.

Phylidorea, as typified by *ferruginea* and *adusta*, includes a considerable range of species, agreeing in the general structure of the male hypopygium. The venation usually shows *Rs* short and strongly angulated to spurred at origin, but this character is closely approximated by a few species with elongate antennae in the male sex that I do not think can be held as being consubgeneric with *adusta* (compare *Limnophila*, s. s.). However, it should be borne in mind that some species that are surely members of *Phylidorea* (*novae-angliae*, *siouana*) have relatively long antennae in the male sex, and there is a possibility that the above-mentioned doubtful species (*laricicola*; *albipes*, *niveitarsis*) will eventually be placed in *Phylidorea*. All three of the species named are very distinct in hypopygial and other characters and are not apt to be confused by the careful student.

Limnophila, as treated for the Northeastern Nearctic fauna, has been made to receive the residue after the various species have been assigned to other subgeneric groups. It is somewhat doubtful whether any of the species here placed in *Limnophila*, s. s., are strictly consubgeneric with the type, *pictipennis* Westwood, of Europe, the nearest approach being in *irrorata*. Besides the four species that approach *Phylidorea*, as listed in the above key, having elongate antennae in the male sex, only two species are left in the group as now restricted. Both of these are readily told from all other Eastern species of the genus by the diagnostic features,—*brevifurca* by its very small cell M_1, and *irrorata* by its heavily and closely irrorate wing-pattern.

A few crane-flies that presumably belong to the Hexatomini have been described by earlier workers but have not been recognized in the intervening years.

Limnophila carbonaria Macq.: Dipt. exot., 1:66; 1838. Unknown: the only species known that agrees even approximately with the description is *L. macrocera* Say (1823).

Limnophila biterminata Walk.; Insecta Saundersiana, 1, Dipt., p. 436; 1856. Dr. Fred W. Edwards sends me the following notes on Walker's type.

Type lacking abdomen and all legs except one mid-femur and tibia. Head (crushed) dull brownish; appendages brown; antennae short. Thorax uniformly shining reddish-brown; scutellum lighter. Mid-femur scarcely darkened at tip; mid-tibial spurs black, as long as tibial diameter. Venation much as in *poetica*, but *Rs* not quite so long and less distinctly spurred; R_{2+3+4} not quite so short; *m-cu* at midlength of cell *1st* M_2. Tiny brown dots at base and tip of *Rs*, over *Sc*, fork of R_{2+3+4}, over R_2 and at tip of R_3. Anal area larger than shown for *poetica* (Cfls. N. Y., 1). Walker gives the length as 12 mm.; wing about 10 mm.

Limnophila ignobilis Walk.; Insecta Saundersiana, 1, Dipt., p. 437; 1856. Dr. Edwards states that the type is lost. Certain features of the original description are suggestive of *Hexatoma* (*Eriocera*).

Subgenus **Lasiomastix** O. S.

1859. *Limnophila* (*Lasiomastix*) Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 233.

The essential characters of the present group lie in the presence of macrotrichia in the outer cells of the wing (Fig. 43, J, K) correlated with venational characters, such as the very short petiole of cell R_3, and the elongate antennae of the male sex. The immature stages are spent in mud or rich organic earth.

Key to Species

1. General coloration of mesonotum polished black; wings subhyaline, with a heavy brown pattern that is more or less cross-banded; antennae (♂) very elongate, approximately as long as the body, the cylindrical segments provided over their entire length with long erect setae that greatly exceed the short, subappressed verticils (Fig. 43, J) .... **macrocera**
   General coloration dull gray; wings grayish subhyaline, unmarked, except for the stigma; antennae (♂) elongate, approximately one-half the length of body, the segments with short verticils at near midlength, these longer than the short dense pubescence 2
2. Cell M_1 lacking (Fig. 43, K) .... **subtenuicornis**
   Cell M_1 present .... **tenuicornis**

Limnophila (*Lasiomastix*) **macrocera** (Say) (Fig. 43, J).

1823. *Limnobia macrocera* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 20.

1869. *Limnophila macrocera* Osten Sacken; Mon. Dipt. N. Amer., 4: 204-205.

Figs.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 113 (wing); 1919. Crampton, Ann. Ent. Soc. Amer., 18, pl. 3, fig. 5 (thorax); 1925. Crampton, Trans. Amer. Ent. Soc., 52, pl. 14, fig. 60 (neck, prothorax); 1926.

Thoracic pleura pruinose. Antennae of female much shorter than in male, if bent backward extending about to wing-root, without erect setae; maxillary palpi elongate, exceeding the head. Wings whitish subhyaline, incompletely cross-banded with dark brown, including

areas at origin of *Rs*, along cord, outer end of cell *1st* M_2 and wing-tip; cell R_3 short-petiolate; *m-cu* subequal to or longer than the distal section of Cu_1. Abdomen (♂) bicolorous, black, the intermediate segments ringed basally with obscure yellow; hypopygium yellow; in female, abdomen more uniformly blackened. ♂. L. 7-8 mm.; w. 7.5-8 mm. ♀. L. 10-11 mm.; w. 8.5-9 mm.

(May-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., R. I., N. Y., Pa., westw. to Mich. and Ill., southw to Ga. and Tenn., in s. Ga. and Fla. replaced by the subspecies *suffusa* Alex., with more heavily patterned wings. A common species, usually in swampy or marshy places.

Connecticut.—Granby, June 8, 1929 (C. P. A.); High Ridge, July 18, 1915 (G. P. E.); Natchaug State Forest, June 14, 1933 (C. P. A.); New Haven, May 26, 1904 (H. L. V.); Norfolk, July 24, 1931 (C. P. A.); Phoenixville, June 14, 1933 (C. P. A.).

L. (*Lasiomastix*) **subtenuicornis** (Alex.) (Fig. 43, K).
1918. *Lasiomastix subtenuicornis* Alexander: Can. Ent., 50: 61-62.

General coloration gray to brownish gray, the praescutum with three broad, slightly darker brown stripes. Antennae (♂) with flagellar segments subcylindrical to long-fusiform, the verticils and pubescence short; in ♀ antennae shorter, extending about to base of abdomen. Wings with cell R_3 sessile to very short-petiolate. ♂. L. 7-7.5 mm.; w. 7.4-8.4 mm. ♀. L. 8.5-9 mm.; w. 8.5-8.8 mm.

(June) Ont. and N. Y., westw. to Ind. and Mich., southw. to Tenn. Swampy and boggy woodlands.

L. (*Lasiomastix*) **tenuicornis** O. S.
1869. *Limnophila tenuicornis* Osten Sacken: Mon. Dipt. N. Amer., 4: 208-209.

Fig.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 117 (wing); 1919.

General coloration gray, the praescutal disk and scutal lobes more infuscated, pruinose laterally; pleura pruinose. Antennae (♂) elongate, nearly one-half the entire body, the structure almost as in the last species. Wings with cell R_3 sessile to very short-petiolate. Abdomen relatively long, dark brown; hypopygium blackened. ♂. L. 7-7.5 mm.; w. 7-7.5 mm. ♀. L. 8-9 mm.; w. 7.5-8.5 mm.

(Late May-July) Ont., Que., Me., N. H., Vt., Mass., N. Y., southw. to Va. and S. C.

Connecticut.—Norfolk, May 31, 1931, June 9, 1929, June 12, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

Subgenus **Dicranophragma** Osten Sacken

1859. *Limnophila* (*Dicranophragma*) Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 240.

The subgenus *Dicranophragma* is represented in our fauna by two common species. The center of distribution for the group lies in the mountains of the Oriental Region. The adult flies may be swept from rank herbage in swampy or boggy woods, where they rest with the

wings folded incumbent over the back and with the body tilted at a strong angle to the support. The early stages are spent in rich organic mud.

Key to Species

1. Wings of both sexes narrow, widest opposite the central half .... **angustula**
   Wings broader, especially in the male, where the widest point is just behind the termination of vein *2nd A* (Fig. 43, L) .... **fuscovaria**

Limnophila (*Dicranophragma*) **angustula** Alex.

1929. *Limnophila* (*Dicranophragma*) *angustula* Alexander: Bull. Brooklyn Ent. Soc., 24: 190-191.

Allied and generally similar to the next species, differing especially in the narrow wings of both sexes. Head and thorax brownish gray, the praescutal interspaces variegated with dark brown. Halteres and legs pale yellow. Wings subhyaline, with an abundant dotted and spotted brown pattern, including about five major areas along the costal field, the third and fourth, in cases, more or less confluent behind. ♂. L. 4.5-5.5 mm.; w. 4.8-7 mm. ♀. L. 5-6 mm.; w. 5-6 mm.

(Mid-June-Sept.) Me., N. H., Vt., Mass., Ct., N. Y., westw. to Mich., southw. to Tenn., N. C. and Fla.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Bolton, July 4, 1931 (W. H. B.); Cornwall Bridge, Aug. 19, 1931 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.).

L. (*Dicranophragma*) **fuscovaria** O. S. (Fig. 43, L).

1859. *Limnophila* (*Dicranophragma*) *fuscovaria* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 240.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 18, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 39, fig. 139 (wing); 1919. Dickinson, Cfls. Wisc., p. 203, fig. 96 (wing ♀); 1932.

Antennae short in both sexes, the basal segments yellow, the outer segments darker. Mesonotum brownish gray, the interspaces variegated by dark brown spots and dashes; pleura clearer gray, lined longitudinally with dark brown; a circular dark spot on sternopleurite. Legs yellow, with conspicuous erect setae. Wings with an abundant dotted and spotted brown pattern, including about five costal areas, the third and fourth widely separated; costal fringe (♂) conspicuous. ♂. L. 4.5-5.5 mm.; w. 6-6.5 mm. ♀. L. 6.5-7 mm.; w. 7 mm.

(June-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc. and Mo., southw. to N. C., S. C., Tenn. and Fla. Cool woodlands.

Connecticut.—Canaan, June 12, 1931 (C. P. A.); Danbury, June 15, 1909 (C. W. J.); East River, July 8, 1910 (Ely); Granby, June 8, 1929 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.); Riverton, July 23, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Tunxis State Park, July 23-24, 1931 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.); Westford, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

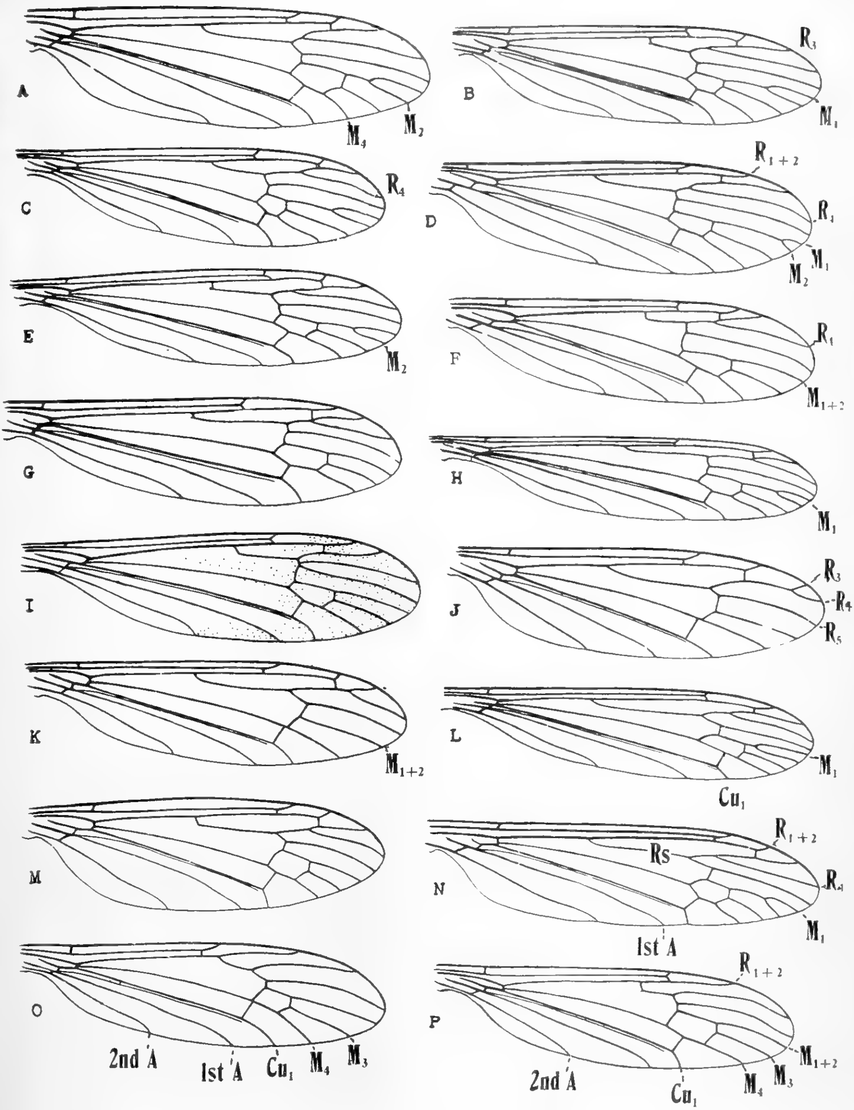


FIGURE 44. Hexatomini; venation.

A. *Limnophila (Prionolabis) rufibasis* O. S.
B. *L. (Phylidorea) adusta* O. S.
C. *L. albipes* Leonard
D. *L. brevifurca* O. S.
E. *L. poetica* O. S.
F. *Shannonomyia lenta* (O. S.)
G. *Pilaria quadrata* (O. S.)
H. *P. tenuipes* (Say)
I. *Ulomorpha pilosella* (O. S.)
J. *Hexatoma (Hexatoma) megacera* (O. S.)
K. *H. (H.) microcera* Alex.
L. *H. (Eriocera) brevioricornis* Alex.
M. *H. (E.) longicornis* (Walk.)
N. *H. (E.) spinosa* (O. S.)
O. *Atarba (Atarba) picticornis* O. S.
P. *Elephantomyia (Elephantomyia) westwoodi* O. S.

Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Rs*, Radial sector.

Subgenus **Idioptera** Macquart

1834. *Idioptera* Macquart; Suit. à Buffon, 1, Hist. Nat. Ins. Dipt.: 94.

The subgenus *Idioptera* is represented in the local fauna by a single rather uncommon species. The adult flies frequent sparsely wooded marshy and boggy areas. The early stages occur in rich organic mud.

Limnophila (*Idioptera*) **fasciolata** O. S. (Fig. 43, M).
1869. *Limnophila fasciolata* Osten Sacken; Mon. Dipt. N. Amer., 4: 206-207.

Fig.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 115 (wing); 1919.

Head and anterior part of mesonotum dark brown, the posterior sclerites of notum and the pleura more yellow, the latter with a transverse brown girdle occupying the anepisternum and sternopleurite. Antennae (♂) elongate, approximately one-half the body; flagellar segments long-cylindrical, with a delicate white pubescence and with verticils at near midlength that are shorter than the segments; in ♀, antennae short, extending to just before wing-root. Legs yellow to whitish, the tips of femora broadly, of tibiae more narrowly, blackened. Wings relatively narrow, whitish subhyaline, with a heavy brown cross-banded pattern. In ♀, wings slightly reduced in size, with the pattern somewhat heavier. Abdomen (♂) elongate, obscure yellow, the segments narrowly bordered by brown; hypopygium chiefly blackened. Male hypopygium with the outer dististyle terminating in a single curved spine. ♂. L. about 6.5-7 mm.; w. 6.5-8 mm. ♀. L. 7-7.5 mm.; w. 6.5-6.8 mm.

(June) Me., Mass., Ct., N. Y., westw. to Mich.

Connecticut.—Manitic Lake, June 8-9, 1929 (C. P. A.).

Subgenus **Elaeophila** Rondani

1856. *Elaeophila* Rondani; Prodr. Dipterol. Italicae, 1: 182.
1864. *Ephelia* Schiner; Wien. Entomol. Monatschr., 7: 222.

There seem to be no sufficient grounds on which we can refuse to use the name *Elaeophila* (*Eloeophila*) for the group that has until recent date been called *Ephelia*. The essential characters of the subgenus lie in the presence of a supernumerary crossvein in cell *M*, in conjunction with the short antennae in both sexes, and the fundamentals of structure of the male hypopygium, especially the rather peculiar structure of the outer dististyle (Fig. 45, C-J). The adult flies rest on rank vegetation in woods and shaded gorges, more especially along streams of various sizes, the nature of the latter to some extent governing the species. Thus, *aprilina* tends to frequent small rills, while *sabrina* and *johnsoni* occur especially along the margins of larger streams. The early stages live in rich organic mud near the haunts of the adult.

Key to Species
(Based chiefly on male characters)

1. Wings pale yellow, unmarked .... **johnsoni**
   Wings heavily spotted and clouded with brown 2
2. Wing-pattern more limited, restricted to the veins, there being a single dark cloud in cell *2nd A*, this located at the end of vein *2nd A* 3
   Wing-pattern more abundant, there being one or more dark clouds in cell *2nd A* proximad of the one at end of vein *2nd A* 5
3. Wings broad, widest opposite the termination of vein *2nd A* .... **aprilina**
   Wings narrower, widest opposite the central third 4
4. Antennae (♂) short, if bent backward ending some distance before wing-root; male hypopygium with the flange of outer dististyle (Fig. 45, E) small, placed on outer half; inner dististyle (Fig. 45, K) with two pencils or tufts of setae .... **irene**
   Antennae (♂) longer, if bent backward extending to shortly beyond the wing-root; male hypopygium with the flange of outer dististyle (Fig. 45, G) large, placed on basal half; inner dististyle without specially modified hair-pencils .... **sabrina**
5. Wing-pattern abundant, with numerous dots and clouds in the cells, including a series of three or four clouds in cell *2nd A*; male hypopygium with the outer dististyle widened distally (Fig. 45, J) .... **vernata**
   Wing-pattern more restricted, with only one or two clouds in the outer end of cell *2nd A*; male hypopygium with the outer dististyle narrowed distally (Fig. 45, H, I) 6
6. Male hypopygium with the tip of the outer dististyle prolonged into a slender lobe that is bifid at apex (Fig. 45, I) .... **solstitialis**
   Male hypopygium with the outer dististyle terminating in a simple acute apical spine (Fig. 45, H) .... **serotinella**

Limnophila (*Elaeophila*) **aprilina** O. S. (Figs. 43, N: 45, C, D).
1859. *Limnophila aprilina* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 235.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 23 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 39, fig. 137 (wing); 1919. Alexander, Bull. Brooklyn Ent. Soc., 22: 64, fig. 2 (hyp.); 1927.

General coloration yellowish gray, the praescutum with four scarcely indicated brown stripes; pseudosutural foveae black, very distinct. Legs yellow, the femora and tibiae weakly darkened at tips. Wings broad in both sexes but more so in male; a series of five or more large costal areas; last marginal darkening at tip of vein *2nd A*. Male hypopygium with the flange of the outer dististyle large and conspicuous, placed on basal half of style (Fig. 45, C, D). ♂. L. 6-7 mm.; w. 7.5-8.7 mm. ♀. L. 7-7.5 mm.; w. 8.5 mm.

(May, June) N. H., Vt., Mass., N. Y., southw. to N. C. and S. C. (Canadian).

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Kent Falls, May 31, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

L. (*Elaeophila*) **irene** Alex. (Fig. 45, E, K).
1927. *Limnophila* (*Ephelia*) *irene* Alexander: Bull. Brooklyn Ent. Soc., 22: 58.

Fig.—Alexander, *Ibid.*, p. 64, fig. 3 (hyp.); 1927.

Generally similar to *aprilina* in the heavy wing-pattern that is restricted to the vicinity of the veins, the last marginal area being that

at the end of vein *2nd A*. Praescutal stripes relatively ill-delimited, straight, the laterals not confluent in front with the median vitta. Male hypopygium with outer dististyle (Fig. 45, E); inner dististyle (Fig. 45, K). ♂. L. about 5.5 mm.; w. 6-6.2 mm. ♀. L. 5.5-6.5 mm.; w. 7.5-8.5 mm.

(June, July) Ont., westw. to Mich., southw. to S. C.

L. (*Elaeophila*) **johnsoni** Alex. (Fig. 45, F).
1914. *Limnophila (Ephelia) johnsoni* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 591.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 2 (ven.); 1914. Alexander, Cfls. N. Y., 1, pl. 39, fig. 138 (ven.); 1919. Alexander, Bull. Brooklyn Ent. Soc., *22*: 64, fig. 1 (hyp.); 1927.

General coloration pale yellow, the four praescutal stripes slightly darker. Male hypopygium (Fig. 45, F). ♂. L. 4-5 mm.; w. 6-7.2 mm. ♀. L. 6.5-7.5 mm.; w. 7-8.5 mm.

(Late May, June) Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., southw. to Va., Tenn., N. C. and S. C. (Canadian).

This species is strikingly distinct from all other members of the subgenus in the yellow body coloration and the immaculate wings.

L. (*Elaeophila*) **sabrina** Alex. (Fig. 45, G).
1929. *Limnophila (Ephelia) sabrina* Alexander; Bull. Brooklyn Ent. Soc., 24: 189-190.

Antennae (♂) with basal flagellar segments enlarged. Wings with pattern restricted to the vicinity of veins, the last dark area at end of vein *2nd A*. Male hypopygium (Fig. 45, G). ♂. L. about 5.5 mm.; w. 5.6-6.8 mm. ♀. L. about 6.5 mm.; w. 7.5 mm.

(June) Que., N. B., N. H., Vt., Mass., Ct., N. Y.

Connecticut.—Winsted, June 9, 1929 (C. P. A.).

L. (*Elaeophila*) **serotinella** Alex. (Fig. 45, H).
1926. *Limnophila (Ephelia) serotinella* Alexander; Bull. Brooklyn Ent. Soc., 21: 110-111.

Fig.—Alexander, *Ibid.*, *22*: 64, fig. 6 (hyp.); 1927.

Size small, the wings with a heavy brown pattern that is more abundant than in *aprilina*. Wings narrow in both sexes. Male hypopygium with outer dististyle (Fig. 45, H) small, dilated on basal half, thence suddenly narrowed to the simple acute apex; outer flange spinous, blunt at tip, placed far out near apex of style. ♂. L. about 4.3 mm.; w. 5-5.3 mm. ♀. L. about 4.3 mm.; w. 4.8 mm.

(Sept.) S. C., Tenn., Fla.

L. (*Elaeophila*) **solstitialis** Alex. (Fig. 45, I).
1926. *Limnophila (Ephelia) solstitialis* Alexander; Bull. Brooklyn Ent. Soc., 21: 109-110.

Fig.—Alexander, *Ibid.*, *22*: 64, fig. 4 (hyp.); 1927.

Wings narrow in both sexes, with an abundant brown pattern. more broken and interrupted than in *aprilina*, there being two dark areas at outer end of cell *2nd A*, the last larger, the penultimate at end of vein *2nd A*. Male hypopygium with outer dististyle (Fig. 45, I): lateral flange placed at about four-fifths the length of style. ♂. L. about 5-5.5 mm.; w. 5.5-7 mm. ♀. L. about 6-6.5 mm.; w. 7-7.5 mm.

(June-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., N. J., westw. to Ind. and Mich., southw. to N. C., S. C., Tenn. and Fla. (Canadian, Transition).

L. (*Elaeophila*) **vernata** Alex. (Fig. 45, J).
1927. *Limnophila* (*Ephelia*) *vernata* Alexander; Bull. Brooklyn Ent. Soc., 22: 59-60.

Fig.—Alexander, *Ibid.*, p. 64, fig. 5 (hyp.); 1927.

A small species with narrow wings, having an unusually abundant clouded and dotted pattern. Male hypopygium with outer dististyle (Fig. 45, J) gently widened outwardly, broadest about opposite the level of the lateral flange, the latter slender and nearly straight; apical spine gently curved. ♂. L. 4-4.3 mm.; w. 5-5.5 mm. ♀. L. about 5.3 mm.; w. 5.8 mm.

(Late Apr.-early June) N. C., s. Ind. (Transition).

Subgenus **Idiolimnophila** Alexander

1934. *Limnophila* (*Idiolimnophila*) Alexander; *in*, Curran, Key to the Families and Genera North American Diptera, p. 40.

Antennae short, the verticils coarse, exceeding the segments. Head broad, not narrowed posteriorly. Tuberculate pits obsolete or nearly so; pseudosutural foveae large, remote from margin. Wings (Fig. 43, O) with cell R_3 narrowly to broadly sessile; cell M_1 lacking; *Sc* ending opposite or just beyond the fork of *Rs*, Sc_2 near the tip of Sc_1; *m-cu* at near midlength of cell *1st* M_2; anterior arculus preserved. Male hypopygium with the outer dististyle profoundly bifid, each arm terminating in an acute blackened point.

Besides the subgenotype, *emmelina* Alexander, it is highly probable that *Limnophila antennata* Coquillett (Western Nearctic) will likewise fall within the limits of the subgenus. The venation is very similar in the two species, but the elongate antennae of the male and the general structure of the male hypopygium are very distinct from the condition found in *emmelina*. The adult flies of this latter species have been swept from rank herbage along small mountain streams. The early stages are quite unknown.

Limnophila (*Idiolimnophila*) **emmelina** Alex. (Fig. 43, O).
1914. *Limnophila emmelina* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 597.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 28 (ven.); 1914. Alexander, Cfls. N. Y., 1, pl. 40, fig. 151; 1919.

General coloration polished reddish yellow or brownish yellow, the praescutum without distinct darker markings, or with a more in-

FIGURE 45. Hexatomini; male hypopygia.

A. *Austrolimnophila harperi* (Alex.)

B. *A. unica* (O. S.)

C. *Limnophila (Elaeophila) aprilina* O. S.

D. *L. (E.) aprilina* O. S.; *od.*

E. *L. (E.) irene* Alex.; *od.*

F. *L. (E.) johnsoni* Alex.; *od.*

G. *L. (E.) sabrina* Alex.; *od.*

H. *L. (E.) serotinella* Alex.; *od.*

I. *L. (E.) solstitialis* Alex.; *od.*

J. *L. (E.) vernata* Alex.; *od.*

K. *L. (E.) irene* Alex.; *id.*

L. *L. (Prionolabis) rufibasis* O. S.

M. *L. (P.) simplex* Alex.

N. *L. (P.) walleyi* Alex.; *id.*

O. *L. albipes* Leonard

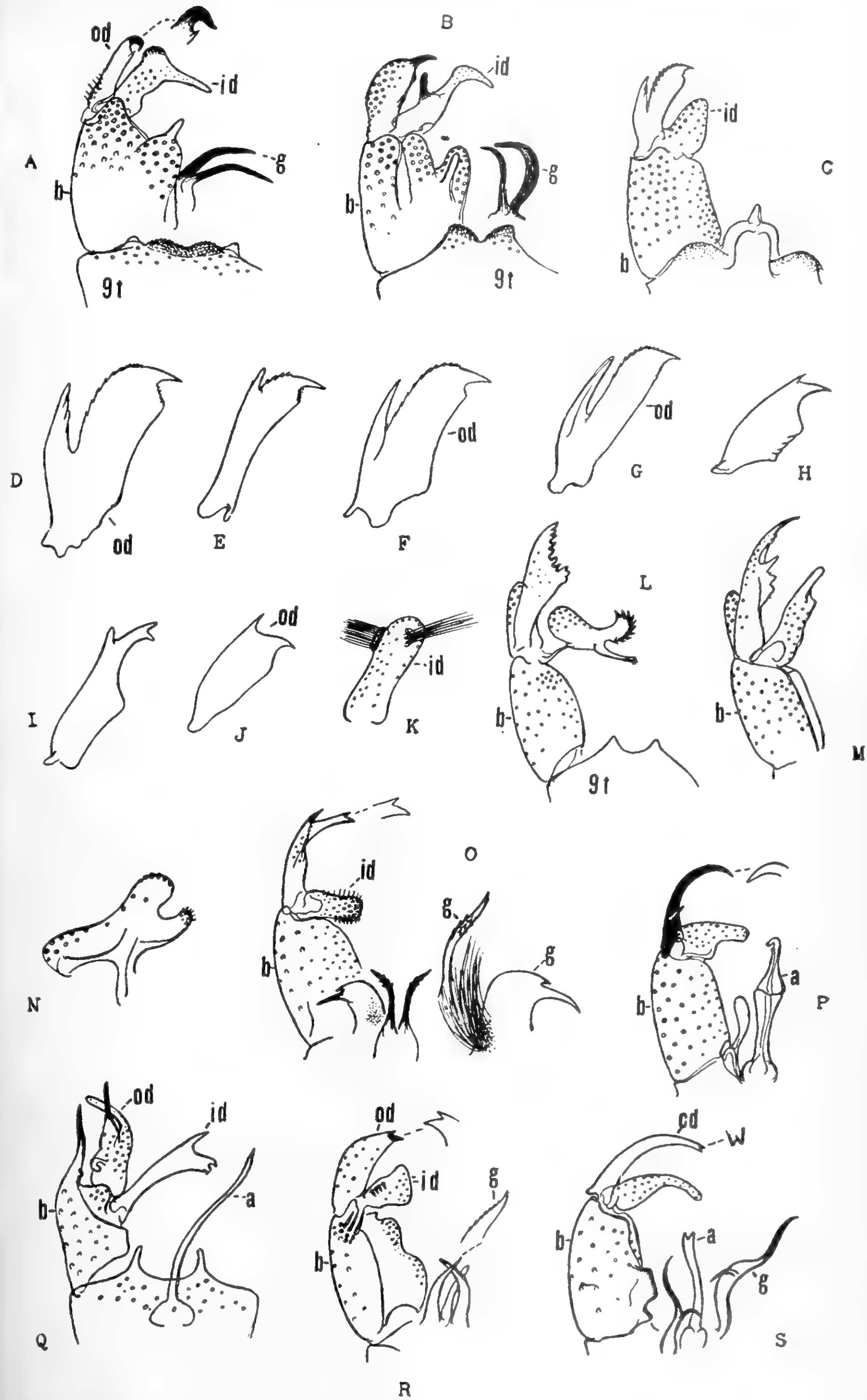
P. *L. irrorata* Johns.

Q. *L. laricicola* Alex.

R. *L. niveitarsis* O. S.

S. *L. poetica* O. S.

Symbols: *a,* aedeagus; *b,* basistyle; *g,* gonapophysis; *id,* inner dististyle; *od,* outer dististyle; *t,* tergite.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tense median darkening. Legs stout, obscure yellow, the tips of the tibiae and the tarsi darkened. Wings with a strong yellow tinge, without a stigmal darkening. Abdomen reddish yellow. ♂. L. 6-7.5 mm.; w. 7.5-9 mm.

(Late Apr.-June) Ont., Mass. and N. Y., southw. to vicinity of D. C. (Canadian, Transition).

Subgenus **Eutonia** van der Wulp

1874. *Eutonia* van der Wulp; Tijdschr. v. Ent., 17:147.

Two very large species of *Limnophila* fall in the present subgenus. These are by far the largest and most conspicuous of all local members of the genus, rivalling in stature and coloration the medium-sized species of *Tipula*. The adult flies of *alleni* are found in low boggy woodlands, of *marchandi* more usually in shaded ravines. The early stages are not known but from tent-trap captures of the adults are presumably to be found in organic mud.

Key to Species

1. Thoracic dorsum gray, the praescutum with three velvety-brown stripes, the middle one narrowly split by a line of the ground-color, the posterior interspaces reddish brown; ground-color of wings brownish yellow; basal abdominal tergites yellowish, without conspicuous brown setigerous punctures; vein R_2 subequal to R_{1+2} (Fig. 43, P) .... **alleni**

   Thoracic dorsum gray, the praescutum with three narrow velvety-brown stripes, the middle one split by a broad pale line; ground-color of wings whitish-hyaline; basal abdominal tergites gray, with conspicuous brown setigerous punctures; vein R_2 about one-half R_{1+2} .... **marchandi**

Limnophila (*Eutonia*) **alleni** Johns. (Fig. 43, P).
1909. *Limnophila alleni* Johnson; Proc. Boston Soc. Nat. Hist., 34: 126-127.

Figs.—Johnson, *Ibid.*, pl. 16, fig. 18 (wing). Alexander, Journ. N. Y. Ent. Soc., 24, pl. 8, fig. 1 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 39, fig. 140 (wing); 1919.

Legs yellow, the tips of femora and tibiae conspicuously blackened; tarsi brownish black. Wings heavily patterned with dark brown, the major areas being costal in distribution, leaving the small stigma yellow; cell *1st* M_2 longer than wide. Basal abdominal segments with caudal margins of tergites more or less darkened medially; outer segments and genitalia of both sexes dark brown. ♂. L. 23-25 mm.; w. 17-18 mm. ♀. L. 27-36 mm.; w. 20-25 mm.

(June) N. H., Vt., N. Y., westw. to O. (Canadian).

L. (*Eutonia*) **marchandi** Alex.
1916. *Limnophila marchandi* Alexander; Journ. N. Y. Ent. Soc., 24: 118-120.

Figs.—Alexander, *Ibid.*, pl. 8, fig. 2 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 39, fig. 141 (wing); 1919.

Generally similar to last, differing especially in the coloration of the body and wings, and in the details of venation. Wings with a

heavy dark brown pattern that is chiefly costal; branches of *M* very strongly divergent, so cell *1st* M_2 is about as wide as long. ♂. L. about 22 mm.; w. 18 mm. ♀. L. about 30 mm.; w. 20 mm.

(May, June) Mass., Ct., southw. to n. Fla.

Connecticut.—Farmington, June 7, 1914 (W. M.); Type: Storrs, without more exact data.

Subgenus **Prionolabis** Osten Sacken

1859. *Limnophila* (*Prionolabis*) Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859:239.

The subgenus *Prionolabis* is represented in the local fauna by six species, with several others occurring in Eastern Asia. The most aberrant species is *mundoides* whose male hypopygium is very remarkable and deviates so greatly from that of the subgenotype that it will very probably require a new group name. *L. munda* and *L. terebrans* also depart in some respects from the accepted characters of the group, but undoubtedly belong here. The typical group of *Prionolabis* includes the type of the subgenus, *rufibasis*, together with *simplex* and *walleyi*. In these three species, the characters of a comb-like outer dististyle and a highly compressed aedeagus are found in the male genitalia. This flattened nature of the aedeagus is closely approached by certain species of the subgenus *Phylidorea* (*platyphallus* group), indicating a probable relationship. All local species of *Prionolabis* have the antennae short in both sexes. The adult flies are found resting on vegetation in open woods, usually near water. The early stages are still unknown.

Key to Species

(Based chiefly on male characters)

1. Mesonotum polished black 2
   Mesonotum with a gray pruinosity 3
2. Wings with a brownish tinge, patterned with darker brown along cord, outer end of cell *1st* M_2 and vein Cu_1; legs stout, conspicuously hairy; femora dull brownish yellow, narrowly tipped with dark brown; male hypopygium of normal limnophiline appearance .... **munda**
   Wings hyaline or nearly so, unmarked except for the stigmal darkening; legs slender, without conspicuous setae; femora dark brown, with only the extreme bases paler; male hypopygium enlarged and very complicated in structure .... **mundoides**
3. Male hypopygium with the outer dististyle not pectinate; legs of female short, clothed with long conspicuous setae; size small (wing, ♂, under 8 mm.) .... **terebrans**
   Male hypopygium with the outer dististyle bearing a series of comb-like teeth along inner margin of distal half; legs of both sexes long and slender, with normal vestiture; size generally larger (wing, ♂, in all except *walleyi*, over 9 mm.) 4
4. Male hypopygium with the inner dististyle simple, terminating in a single point (Fig. 45, M) .... **simplex**
   Male hypopygium with the inner dististyle bifid (Fig. 45, L, N) 5
5. Size large (wing over 9 and usually over 10 mm.); male hypopygium with the inner dististyle bearing conspicuous erect serrations, the inner arm slender (Fig. 45, L); wings with a dark seam along vein Cu_1 .... **rufibasis**
   Size smaller (wing under 8.5 mm.); male hypopygium with the inner dististyle having both arms short and obtuse, the outer with short appressed serrations (Fig. 45, N); wings without a darkened seam along vein Cu_1 **walleyi**

The identity of *L.* (*P.*) *magdalena* Dtz. (Can. Ent. 52:5-6; 1920), described from the Magdalen Islands, Eastern Quebec, remains in question. The description indicates that the name pertains to a member of the typical subgroup, calling for a species of medium size, not unlike *simplex*. The description of the male hypopygium further indicates a species having the inner dististyle simple, as in *simplex*, and the fly would run to this latter species by means of the key provided at this time.

Limnophila (*Prionolabis*) **munda** O. S.
1869. *Limnophila munda* Osten Sacken; Mon. Dipt. N. Amer., 4: 226-227.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 18, fig. 4 (ven.); 1908, figure erroneous. Alexander, Journ. N. Y. Ent. Soc., 24, pl. 8, fig. 4 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 40, fig. 144 (wing); 1919.

Mesonotum polished black, the pleura more pruinose. Wings with cell M_1 variable in length, from equal to its petiole to twice this length. Male hypopygium with the region of the tergite strongly produced medially, the apex broadly and shallowly emarginate; outer dististyle long and slender, its distal half more narrowed and blackened, the apex bifid, before apex on inner face with a weakly toothed flange; inner dististyle terminating in a simple compressed blade; aedeagus not conspicuously compressed. ♂. L. 7-8.5 mm.; w. 7.5-8.5 mm. ♀. L. 6.5-7.5 mm.; w. 5.5-7.5 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Wisc., southw. to N. C. (Canadian).

L. (*Prionolabis*) **mundoides** Alex.
1916. *Limnophila mundoides* Alexander; Journ. N. Y. Ent. Soc., 24: 120-121.

Figs.—Alexander, *Ibid.*, pl. 8, fig. 3 (ven.); 1916. Alexander, Cfls. N. Y., 1, pl. 40, fig. 145 (ven.); 1919.

Polished black, including the thoracic pleura. Legs yellow, the femora tipped with brown, most extensive on the fore legs where the outer half is included, narrowest on the posterior legs. Male hypopygium enlarged and complicated in structure. Ninth tergite produced into a slender median lobe; ninth sternite produced into two longer submedian lobules; basistyles with large ventral lobes that terminate in dense brushes; outer dististyle a slender sinuous hook; inner dististyle large and massive. ♂. L. 5.4-5.6 mm.; w. 6-6.2 mm.

(May, June) Pa., Md., Va., N. C., nw. Fla. (Transition).

L. (*Prionolabis*) **rufibasis** O. S. (Figs. 44, A; 45, L).
1859. *Limnophila* (*Prionolabis*) *rufibasis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 239.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 3 (wing), pl. 4, fig. 27 (hyp.); 1869. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 9, fig. 17, 21-23, 25 (hyp.); 1904. Johnson, Proc. Boston Soc. Nat. Hist., 34, pl. 16, figs. 21-23 (ven.); 1909. Alexander, Psyche, 18, pl. 16, fig. 11 (hyp.); 1911. Alexander, Cfls. N. Y., 1, pl. 40, fig. 142 (wing); 1919. Crampton, Trans. Amer. Ent. Soc., 48, pl. 10, fig. 36 (hyp.); 1923. Dickinson, Cfls. Wisc., p. 204, fig. 101 (wing); 1932.

General coloration black, dusted with gray. Praescutum yellowish gray, with scarcely indicated more shiny stripes. Legs obscure yellow, the femoral tips broadly brownish black, most extensive on the fore legs; tibiae narrowly tipped with black. Wings yellowish gray, more yellow basally; stigma dark brown; cord, outer end of cell *1st* M_2 and vein Cu_1 seamed with pale brown. Male hypopygium (Fig. 45, L) with the pectinations of the outer dististyle variable in number and degree. ♂. L. 8.5-11 mm.; w. 9-12 mm. ♀. L. 11-14 mm.; w. 11.5-13.5 mm.

(May, June) Ont., Que., Nfd., N. B., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Wisc., southw. to N. C. and S. C.

One of the largest and most common members of the genus in the local fauna.

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Cornwall Bridge, May 30, 1931 (C. P. A.); Danbury, June 15, 1909 (C. W. J.); Eastford, June 12, 1919 (W. E. B.); Hamden, June 21, 1928 (R.B. F.); Kent Falls, May 31, 1931 (C. P. A.); Meriden, May 28, 1930 (R.B. F.); Middlebury, June 2, 1919 (W.E. B.); Montville, June 12, 1929 (R. B. F.); New Haven, May 31, 1929 (R. B. F.); Norfolk, May 31, 1931, June 9, 1929, June 12, 1931 (C. P. A.); Riverton, May 30-31, 1931 (C. P. A.); Rowayton, June 16, 1909 (C. W. J.); Salisbury, June 10, 1928 (R. B. F.); Storrs, May 14, 1928, June 1, 1933, June 2, 1927 (J. A. M.); Tunxis State Park, June 12, 1931 (C. P. A.); Tyler Lake, May 30, 1931, June 13, 1931 (C. P. A.); Westbrook, June 5, 1929 (B. H. W.); W. Granby, June 8, 1929 (C. P. A.); W. Hartford, June 10, 1929 (R. B. F.).

L. (*Prionolabis*) **simplex** Alex. (Fig. 45, M).
1911. *Limnophila* (*Prionolabis*) *simplex* Alexander; Psyche, 18: 198-199.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 10 (hyp.); 1911. Alexander, Cfls. N. Y., 1, pl. 40, fig. 143 (wing); 1919.

Generally similar to *rufibasis*, differing especially in the structure of the male hypopygium (Fig. 45, M). Outer dististyle more irregularly pectinate, with one outstanding denticle at near midlength. Wing-base not so conspicuously brightened as in *rufibasis*. ♂. L. 10-11 mm.; w. 9.5-11.5 mm.

(May, June) N. H., N. Y., southw. to N. C., Ga. and Fla.

L. (*Prionolabis*) **terebrans** Alex.
1916. *Limnophila terebrans* Alexander; Journ. N. Y. Ent. Soc., 24: 121-122.

Figs.—Alexander, *Ibid.*, pl. 8, fig. 5 (wing). Alexander, Cfls. N. Y., 1, pl. 40, fig. 146 (wing); 1919.

Black, the thorax covered with a yellowish gray pollen. Legs conspicuously hairy, especially in the female where they are notably shorter than in male; femora yellow, tipped with brown, most extensive on the fore legs where the outer half is included, narrowest on the posterior legs where only the tips are darkened. Male hypopygium with the outer dististyle lacking the comb-like denticles of *rufibasis* and allies. ♂. L. about 7.5 mm.; w. 7.7 mm. ♀. L. about 8 mm.; w. 8-8.3 mm.

(Late Apr., May) N. J., to vicinity of D. C.

L. (*Prionolabis*) **walleyi** Alex. (Fig. 45, N).
1929. *Limnophila* (*Prionolabis*) *walleyi* Alexander; Bull. Brooklyn Ent. Soc., 24: 187-188.

In its relatively small size and general appearance, most resembling *simplex* but with the inner dististyle of the male hypopygium bifid as in *rufibasis*. Mesonotal praescutum dark yellowish gray pruinose, without stripes. Wings grayish yellow, inconspicuously patterned with darker; stigma small but well-defined. Male hypopygium (Fig. 45, N) with the outer dististyle weakly and irregularly pectinate. ♂. L. 6.5-7.5 mm.; w. 7-8 mm.

(May, June) Ont., and N. Y., westw. to Mich. and Ill., southw. to N. C.

Subgenus **Phylidorea** Bigot

1854. *Phylidorea* Bigot; Ann. Soc. Ent. France, 1854: 456.

The subgenus *Phylidorea*, as typified by the European *ferruginea* (Meigen) includes, in the Northern Hemisphere, a large number of species that are very difficult of exact definition. In general, the flies are shiny reddish or yellowish, with gray heads, and with the antennae beyond the scapal segment yellowish to brownish yellow. Only two of the numerous local species have the body-coloration gray, and one of these (*subcostata*) is atypical. The various species fall into more or less natural groups that are separated primarily on the structure of the male hypopygium. These groups, as represented in the present fauna, are as follows:

1. The *subcostata* group. Male hypopygium with the outer dististyle slender, entirely blackened, bifid at apex. Aedeagus elongate, much exceeding the dististyles in length; gonapophyses simple, stout, at apex with many irregular denticles (Fig. 46, K) .... **subcostata**
2. The *lutea* group. Male hypopygium with the aedeagus very long, subtended at near midlength by an expanded flange that is armed with small, retrorse, spinous points; at base of aedeagus with three short, blackened, spike-like apophyses. (Fig. 46, E) .... **lutea**
   L. fratria also presumably falls here, agreeing in its general features, but differing in the nature of the gonapophyses (Fig. 46, D).
3. The *adusta* group. Male hypopygium with the aedeagus and subtending pair of apophyses very greatly elongated, in length exceeding either of the dististyles; basal apophyses simple or but inconspicuously branched at apex or beyond midlength (Fig. 46, A, B, F) .... **adusta; caudifera; neadusta**
4. The *similis* group. Male hypopygium with the aedeagus and subtending pair of apophyses short, not or but slightly exceeding the dististyles in length; basal apophyses profoundly bifid (Fig. 46, C, I).
   A. The *consimilis* subgroup.—Femora blackened, yellow basally (except in *nigrogeniculata*); cord and vein *Cu* of wings not darkened.
   consimilis; fumidicosta; luteola; nigrogeniculata; persimilis
   B. The *similis* subgroup.—Femora yellow, with a narrow dark ring at or immediately before tips; cord and vein *Cu* of wings narrowly seamed with darker .... **adustoides; auripennis; iowensis; similis**
5. The *fulvonervosa* (*platyphallus*) group. Male hypopygium with the aedeagus greatly compressed, in outline appearing pod-shaped or reniform, least modified in *novae-angliae*; gonapophyses very like those of the *similis* group, of which this is obviously an offshoot (Fig. 46, G, H, J).
   novae-angliae; platyphallus; siouana; and presumably **terrae-novae**

The adult flies are most often found by sweeping vegetation in shaded moist places. *L. subcostata* frequents open gorges and cold boggy woods; *luteola*, *novae-angliae*, *platyphallus* and *terrae-novae* in and near margins of cold bogs. The other species occur along streams and in open woodlands. The early stages, as known, are spent in rich organic mud.

Key to Species

(Based chiefly on male characters)

1. General coloration of thorax light gray; wings unmarked, except for the stigma when this is evident 2
   General coloration shiny reddish or yellowish to dark brown; if at all pruinose, the wings are suffused with darker, at least on the costal and apical portions 3
2. Wings with *Rs* short, angulated and often spurred at origin; *Rs* without macrotrichia; femora chiefly brownish black, their bases narrowly yellowish, this including less than the proximal half .... **subcostata**
   Wings with *Rs* unusually long for a member of this subgenus, about equal in length to the anterior branch of *Rs*, arcuated at origin; *Rs* with macrotrichia for almost the entire length; femora chiefly obscure yellow, the tips narrowly darkened .... **fratria**
3. Wings unmarked, except for the slightly darker stigmal area 4
   Wings more or less patterned with darker, at least the outer radial cells clouded 6
4. Abdomen (♂) uniformly brownish yellow, without a distinct dark subterminal ring; antennae (♂) brownish yellow, short, if bent backward not extending to the wing-root; male hypopygium (Fig. 46, E) with the gonapophyses appearing as three short, dagger-like, blackened points, surrounded at base by scale-like spinulae, the median point smallest .... **lutea**
   Abdomen (♂) brownish yellow, with a blackened subterminal ring; antennae (♂) dark brown, elongate, if bent backward extending approximately to root of halteres; male hypopygium (Fig. 46, G, J) without dagger-like, blackened gonapophyses 5
5. Male hypopygium (Fig. 46, J) with the aedeagus greatly compressed, pod-shaped or reniform in outline .... **siouana**
   Male hypopygium (Fig. 46, G) with the aedeagus only slightly compressed .... **novae angliae**
6. Wings with the disk clear, the costal region and apex strongly suffused with brown, the cord not or scarcely marked with darker; mesonotum dark brown; male hypopygium (as known) with the aedeagus greatly compressed, pod-shaped in outline (Fig. 46, H) 7
   Wings without such a combination of infumed costal and apical regions, in conjunction with an unseamed cord (compare *fumidicosta*); mesonotum shiny reddish or ferruginous, rarely dark brown (*similis*, *neadusta*); male hypopygium with the aedeagus cylindrical or nearly so (Fig. 46, A, B, C) 8
7. *Rs* almost without macrotrichia, only with two or three at near midlength .... **terrae novae**
   Rs with from ten to fifteen macrotrichia, distributed for almost the entire length .... **platyphallus**
8. Femora uniformly yellow .... **auripennis**
   Femora more or less extensively dark brown at tips 9
9. Wings with an apical darkening but with no seams along the cord or vein Cu_1; femora chiefly blackened, with more than the distal half dark (except in *nigrogeniculata*). (*consimilis* subgroup) 10
   Wings with a narrow but distinct brown clouding along the cord and vein Cu_1, in addition to the apical darkening; femora chiefly yellow, only the narrow tips dark brown to black. (*similis* subgroup) 14
10. Femora yellow, the tips narrowly and conspicuously blackened **nigrogeniculata**
    Femora, especially of fore legs, black, only the bases restrictedly brightened 11

11. Wings clear light yellow, including the costal field; abdomen (♂) brownish yellow, without a distinct darkened subterminal ring .... **luteola**
    Wings grayish or yellowish subhyaline; abdomen (♂) with a dark brown to blackish subterminal ring (except in *persimilis*) 12
12. Stigma not or scarcely indicated; wing-tip very narrowly and vaguely infumed; male hypopygium with the aedeagus elongate, black, fully one-half longer than the branched gonapophyses .... **persimilis**
    Stigma dark brown; wing-tip conspicuously infumed; male hypopygium with the aedeagus pale, subequal to or slightly longer than the branched gonapophyses 13
13. Outer end of cell *C* strongly infumed .... **fumidicosta**
    Costal cell not infumed .... **consimilis**
14. Male hypopygium with the aedeagus and gonapophyses short, not exceeding the outer dististyle in length; basal gonapophyses profoundly branched (Fig. 46, I) (*similis* group) 15
    Male hypopygium with the aedeagus and gonapophyses very elongate, exceeding the outer dististyle in length; basal gonapophyses simple or only weakly branched beyond midlength (Fig. 46, A, B, F) (*adusta* group) 17
15. General coloration of mesonotum dark brown .... **similis**
    General coloration of mesonotum polished rusty-red 16
16. Tips of femora narrowly and abruptly blackened; abdomen (♂) with a black subterminal ring; male hypopygium with the aedeagus black, subequal to or longer than the basal gonapophyses .... **adustoides**
    Tips of femora gradually but narrowly infuscated; abdomen without a dark subterminal ring; male hypopygium with the aedeagus pale, very small, shorter than the basal gonapophyses .... **iowensis**
17. Male hypopygium with the median region of tergite produced into a conspicuous finger-like lobe; inner dististyle straight or nearly so (Fig. 46, B) .... **caudifera**
    Male hypopygium with the median region of tergite not so produced; inner dististyle bent at midlength into a right angle (Fig. 46, A, F) 18
18. Wings with dark pattern along cord reduced to a narrow line; male hypopygium (Fig. 46, F) with basal gonapophyses appearing as powerful blackened rods, each of which bears a short lateral spine at near two-thirds the length .... **neadusta**
    Wings with dark pattern along cord conspicuous; male hypopygium (Fig. 46, A) with basal gonapophyses appearing as very slender, unbranched rods .... **adusta**

Limnophila (*Phylidorea*) *adjuncta* Dietz (Can. Ent., 52:6-7; 1920), described from Cape Breton Island, Nova Scotia, seems certainly to refer to *terrae-novae* and is so considered in this report.

Limnophila (*Phylidorea*) **adusta** O. S. (Figs. 44, B; 46, A).

1859. *Limnophila adusta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:235.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 18, fig. 5 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 39, fig. 128 (wing); 1919. Dickinson, Cfls. Wisc., p. 204, fig. 99 (wing); 1932.

General coloration shiny yellow to rusty brown, with indications of darker stripes, the pleura more pollinose. Antennae short, yellowish, the scape a little darker; head black, pruinose. Legs yellow, the femora with a narrow, nearly terminal, brown ring; tips of tibiae narrowly dark brown. Wings pale yellow, with a handsome darker pattern, including costal and apical cloudings and conspicuous seams along cord and vein Cu_1. Abdomen (♂) pale brown, blackened subterminally; hypopygium fulvous-yellow. Male hypopygium (Fig.

46, A). ♂. L. 9-11 mm.; w. 8-11.5 mm. ♀. L. 11-14 mm.; w. 11-13 mm.

(Late May-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Ill., Mich. and Wisc., southw. to N. C.

Connecticut.—Danbury, June 15, 1909 (C. W. J.); East River, Sept. 1910 (Ely); New Haven, June 11, 1914 (collector?); Rowayton, May 27, 1913 (collector?); Tyler Lake, June 13, 1931 (C. P. A.).

L. (*Phylidorea*) **adustoides** Alex.
1927. *Limnophila (Phylidorea) adustoides* Alexander: Bull. Brooklyn Ent. Soc., 22: 63-64.

Belongs to the *similis* group and subgroup. Antennal flagellum light yellow. Wings strongly suffused with yellow, the base and costal region clearer yellow to very pale brown; wing-tip broadly darkened. Abdomen brownish yellow; hypopygium dark ferruginous. Male hypopygium with aedeagus black, slender, subequal to or longer than the basal gonapophyses. ♂. L. 8-11 mm.; w. 9-11 mm. ♀. L. 10-14 mm.; w. 10.5-13 mm.

(June, July) Mass., westw. to Ind. and Tenn.

L. (*Phylidorea*) **auripennis** Alex.
1926. *Limnophila (Phylidorea) auripennis* Alexander: Bull. Brooklyn Ent. Soc. 21: 113-114.

Fig.—Alexander, Psyche, 18, pl. 16, fig. 9 (hyp.); 1911; as *adusta*.

Belongs to the *similis* group and subgroup. General coloration ferruginous-yellow. Antennal flagellum yellow. Wings strongly tinged with yellow, the costal margin more saturated; wing-tip and cord vaguely seamed with darker. Abdomen ferruginous-yellow, in male without a dark subterminal ring. Male hypopygium with the aedeagus slender, gently curved at apex, a trifle longer than the gonapophyses. ♂. L. 8-9 mm.; w. 8.5-9.5 mm. ♀. L. 10.5-11.5 mm.; w. 10-11 mm.

(Late May-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Ill. and Mich.

Connecticut.—Storrs (C. S. C.); Union, Aug. 17-18, 1928 (C. F. C.).

L. (*Phylidorea*) **caudifera** Alex. (Fig. 46, B).
1927. *Limnophila (Phylidorea) caudifera* Alexander: Bull. Brooklyn Ent. Soc., 22: 111.

Belongs to the *adusta* group. Closely allied and generally similar to *adusta*, differing notably in the structure of the male hypopygium. General coloration of mesonotum shiny brown. Legs with femora bright yellow, passing into brown, the tips dark brown. Wings with a faint yellowish tinge, the costal and apical portions infuscated; a conspicuous seam along vein Cu_1, with a narrower seam along cord. Abdomen obscure brownish yellow, with a dark brown subterminal ring (♂). Male hypopygium (Fig. 46, B): basistyle with dorsal lobe provided with long yellow setae; outer dististyle very broad and

FIGURE 46. Hexatomini: *Limnophila (Phylidorea)*: male hypopygia. *Elephantomyia*; head.

A. *Limnophila (Phylidorea) adusta* O. S.

B. *L. (P.) caudifera* Alex.

C. *L. (P.) consimilis* Dtz.

D. *L. (P.) fratria* O. S.

E. *L. (P.) lutea* Doane

F. *L. (P.) neadusta* Alex.

G. *L. (P.) novae-angliae* Alex.

H. *L. (P.) platyphallus* Alex.

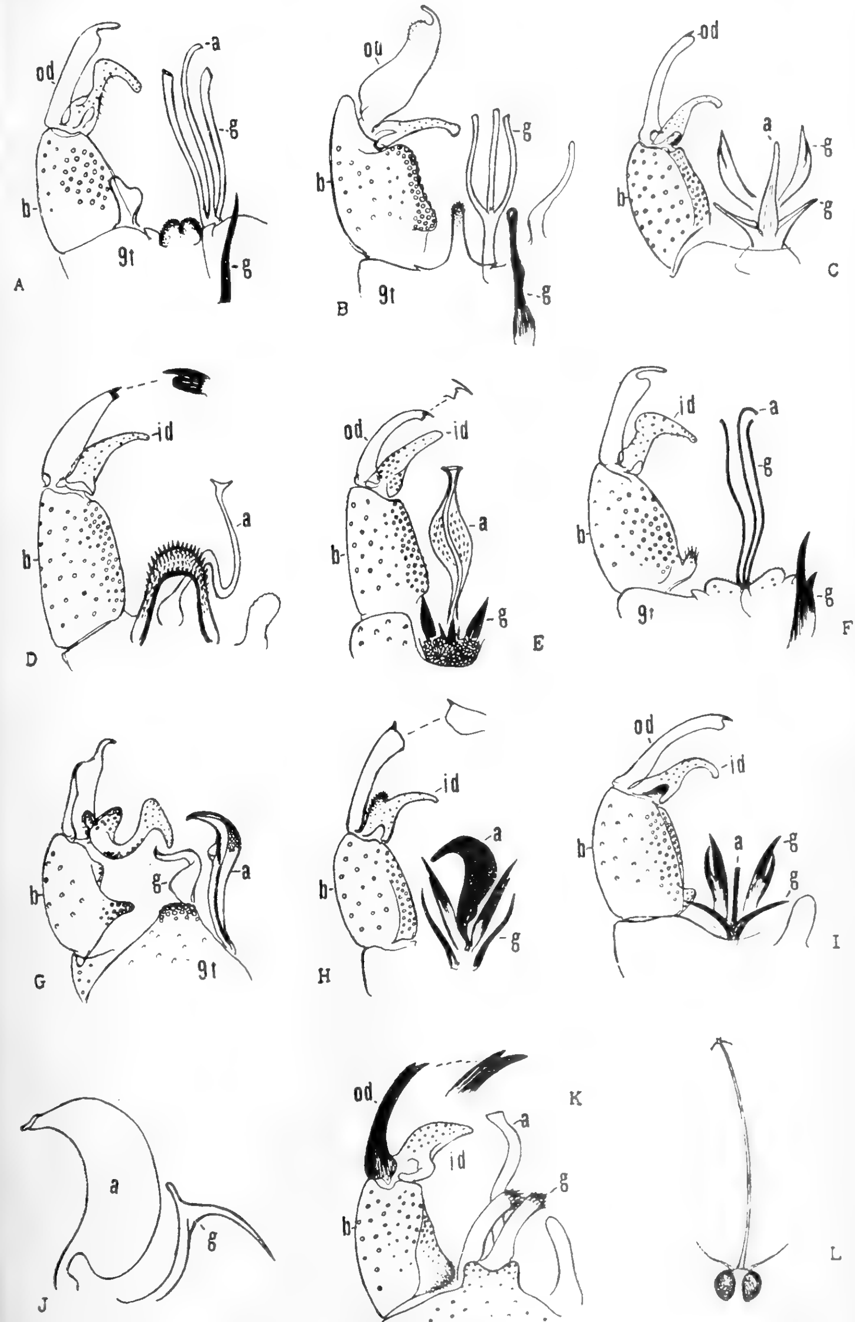
I. *L. (P.) similis* Alex.

J. *L. (P.) siouana* Alex.

K. *L. (P.) subcostata* Alex.

L. *Elephantomyia (Elephantomyia) westwoodi* O. S.; head.

Symbols: *a*, aedeagus; *b*, basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *t*, tergite.


A
B
C
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flattened, the tip suddenly narrowed into a slender finger-like point, near outer end of style with microscopic setulae; basal gonapophyses slender, nearly straight, heavily blackened, beyond midlength a little dilated but not branched; aedeagus and subtending apophyses of moderate length, with a long basal fusion. ♂. L. 8.5-9.5 mm.; w. 9-10 mm.

(June) N. H., Vt. and N. Y., westw. to Mich.

L. (*Phylidorea*) **consimilis** Dtz. (Fig. 46, C).
1921. *Limnophila consimilis* Dietz; Trans. Amer. Ent. Soc., 47: 255-256.

Belongs to the *similis* group. General coloration yellowish. Antennal flagellum yellowish brown. Head gray. Pale femoral bases narrowest on fore legs (basal fourth to fifth), widest on posterior legs (basal half). Wings yellowish subhyaline, the stigma and wing-tip weakly infumed; R_{2+3+4} with macrotrichia, in cases over the entire length. Abdomen yellowish brown, in ♂ with a slightly darker subterminal ring. Male hypopygium (Fig. 46, C) with the aedeagus and gonapophyses relatively small and weak; branches of basal gonapophyses closely appressed. ♂. L. 7-8.5 mm.; w. 7-8.5 mm. ♀. L. 9-10 mm.; w. 9-9.5 mm.

(June, July) Que., Vt., Mass., Ct., N. Y., westw. to Mich., southw. to N. C. and Tenn.

Connecticut.—East River, June 1911 (Ely).

L. (*Phylidorea*) **fratria** (O. S.) (Fig. 46, D).
1869. *Limnophila fratria* Osten Sacken; Mon. Dipt. N. Amer., 4: 220-221.

General coloration dark, heavily and uniformly gray pruinose, the disk of praescutum more infuscated. Antennae dark brown, the scape pruinose; flagellar segments oval. Pseudosutural foveae black, very conspicuous. Legs with tibiae brown, the tips narrowly blackened; tarsi black. Wings tinged with yellowish brown, the stigma darker. Abdominal tergites dark brown; sternites obscure yellow medially, margined with brown laterally; hypopygium bright yellow. Male hypopygium (Fig. 46, D) with the outer dististyle flattened, yellow, only the bidentate apex blackened; aedeagus very long; gonapophyses not evident in the unique available specimen, possibly modified into the curious operculate spinous cushion that occupies the median region of genital chamber. ♂. L. 8-8.5 mm.; w. 8.5-9 mm.

(June, early July) Me., N. H., Vt., N. Y., southw. to Pa.

L. (*Phylidorea*) **fumidicosta** Alex.
1927. *Limnophila* (*Phylidorea*) *fumidicosta* Alexander; Bull. Brooklyn Ent. Soc., 22: 115.

Belongs to the *similis* group, *consimilis* subgroup. General coloration orange-ferruginous. Antennae with pedicel and basal three or four flagellar segments yellow, the outer segments passing into pale brown. Head light gray. Legs with femora dark brown, their bases

yellow, least extensive on fore legs. Wings tinged with yellow: cell *C* beyond basal fourth distinctly infumed; wing-apex darkened; R_{2+3+4} without macrotrichia. Male hypopygium with the arms of the branched gonapophyses long and slender, blackened at tips; aedeagus small, shorter than the branched apophyses. ♂. L. about 7 mm.; w. 7.8 mm.

(June) Mass., N. Y. Probably only a race or color form of *consimilis*.

L. (*Phylidorea*) **iowensis** Alex.
1927. *Limnophila* (*Phylidorea*) *iowensis* Alexander; Bull. Brooklyn Ent. Soc., 22: 112-113.

Belongs to the *similis* group and subgroup. Legs with tibiae brownish yellow, the tips very narrowly darkened. Wings with a yellowish tinge, the base and costal region clearer yellow. Male hypopygium with the aedeagus feebly sclerotized, weak, shorter than the basal gonapophyses. ♂. L. 9-10 mm.; w. 9-9.5 mm. ♀. L. 9-10.5 mm.; w. 9-10 mm.

(June) Mich., Ia.

L. (*Phylidorea*) **lutea** Doane. (Fig. 46, E).
1900. *Limnophila lutea* Doane; Journ. N. Y. Ent. Soc., 8: 191.

Figs:—Doane, *Ibid.*, pl. 8, fig. 4 (ven.); 1900. Alexander, Cfls. N. Y., 1, pl. 39, fig. 132 (ven.); 1919.

General coloration dull brownish yellow, the praescutum opaque, without darker markings. Antennae with flagellum brownish yellow to pale brown. Legs brownish yellow, the femoral bases clear yellow, the outer segments of leg passing into brown. Wings uniformly yellow, the stigma a trifle darker. Male hypopygium (Fig. 46, E) with the outer dististyle relatively slender, irregularly bidentate at apex; inner dististyle shorter, gradually narrowed to the obtuse tip; aedeagus elongate, slender, more enlarged at end, subtended by an expanded flange set with microscopic retrorse points. ♂. L. 5-7 mm.; w. 6.5-9.5 mm. ♀. L. 8-9 mm.; w. 7.5-8.5 mm.

(Late May-Aug.) N. B., Me., N. H., Vt., Mass., N. Y., southw. to Va. and Tenn.

Connecticut.—Hamden, June 11, 1914 (W. E. B.); Storrs; Tunxis State Park, June 12, 1931 (C. P. A.).

L. (*Phylidorea*) **luteola** Alex.
1927. *Limnophila* (*Phylidorea*) *luteola* Alexander; Bull. Brooklyn Ent. Soc., 22: 113-114.

Belongs to the *similis* group, *consimilis* subgroup. General coloration dark ferruginous. Antennal flagellum yellow, the outer segments darker; head light gray. Femora black, the bases extensively yellow, on fore legs including nearly the basal third, on the posterior legs including more than the basal half. Wings strongly suffused with yellow, including the clearer yellow basal and costal regions; stigma and wing-tip darkened; R_{2+3+4} without macrotrichia. Abdomen obscure brownish yellow, without a darkened subterminal ring in

♂, at most the eighth segment weakly infuscated. Male hypopygium with the branched gonapophyses strongly blackened; aedeagus weak, equal in length to its subtending apophyses. ♂. L. about 9 mm.; w. 9 mm. ♀. L. 8.5-10 mm.; w. 8.5-9.5 mm.

(June) Que., Vt., N. Y. Especially characteristic of cold *Iris* bogs. The unusually handsome light yellow wings distinguish the fly from the closely allied *consimilis* and *fumidicosta*.

L. (*Phylidorea*) **neadusta** Alex. (Fig. 46, F).
1927. *Limnophila* (*Phylidorea*) *neadusta* Alexander; Bull. Brooklyn Ent. Soc., 22: 110-111.

Belongs to the *adusta* group. Closely allied and generally similar to *adusta*, differing especially in the structure of the male hypopygium. Mesonotum darker colored, brown medially. Legs with the tips of the femora rather broadly infuscated. Male hypopygium (Fig. 46, F) with the median lobe of ninth tergite much more extensive, its caudal margin with a very shallow notch; outer dististyle with the apical point long and slender; outer gonapophyses and aedeagus very long and unusually slender. ♂. L. about 8.5 mm.; w. 9 mm.

(June) N. Y.

L. (*Phylidorea*) **nigrogeniculata** Alex.
1926. *Limnophila* (*Phylidorea*) *nigrogeniculata* Alexander; Bull. Brooklyn Ent. Soc., 21: 114-115.

Belongs to the *similis* group, *consimilis* subgroup. General coloration shiny ferruginous. Antennal flagellum yellow; head gray. Wing with R_{2+3+4} having macrotrichia throughout its length. Abdomen obscure yellow, with a brownish black subterminal ring (♂). Male hypopygium with the outer dististyle unusually slender and heavily chitinized, terminating in two acute teeth; branched gonapophyses with the arms unusually long and slender, blackened. ♂. L. 5-5.5 mm.; w. 6-6.5 mm. ♀. L. 6.5-8 mm.; w. 6-8 mm.

(July) Tenn.

Amply distinct from the other members of the subgroup in the narrowly blackened tips of the femora.

L. (*Phylidorea*) **novae-angliae** Alex. (Fig. 46, G).
1914. *Limnophila novae-angliae* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1914: 594.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 4 (ven.); 1914. Alexander, Cfls. N. Y., 1, pl. 39, fig. 131 (ven.); 1919.

Belongs to the *platyphallus* group. General coloration shiny reddish yellow, the mesonotum without markings. Head chiefly dark. Legs yellow, the tips of femora and tibiae narrowly darkened. Wings with a strong yellow to brownish yellow tinge, the stigma a trifle darker. Male hypopygium (Fig. 46, G) with the region of the tergite strongly produced, narrowed to a truncated lobe that bears several long powerful setae; outer dististyle entirely glabrous, narrowed into a

gently curved apical point; inner dististyle with a large basal setiferous lobe, the outer portion of style strongly bent at near midlength into a straight terminal portion. ♂. L. 6.5-7.5 mm.; w. 5.8-7.2 mm. ♀. L. 7-8 mm.; w. 6.5-7.5 mm.

(July, Aug.) Que., Me., Mass., N. Y., Pa.

L. (*Phylidorea*) **persimilis** Alex.
1927. *Limnophila* (*Phylidorea*) *persimilis* Alexander; Bull. Brooklyn Ent. Soc., 22: 62-63.

Belongs to the *similis* group, *consimilis* subgroup. General coloration of thorax ferruginous. Antennal flagellum yellow; head light silvery gray. Femora brownish black, the bases yellow, on fore legs including about basal fourth, on middle and hind legs about basal third. Wings pale yellow; sparse macrotrichia on R_{2+3+4}. Abdomen obscure yellow without a conspicuous darkened subterminal ring. ♂. L. 6.5-7 mm.; w. 6.5-7.5 mm. ♀. L. 8-9 mm.; w. 7.8-9 mm.

(June) S. Ind.

The wing-pattern is the palest of any member of the *consimilis* subgroup, in some cases being very nearly immaculate.

L. (*Phylidorea*) **platyphallus** Alex. (Fig. 46, H).
1926. *Limnophila* (*Phylidorea*) *platyphallus* Alexander; Bull. Brooklyn Ent. Soc., 21: 111-112.

General coloration chestnut-brown, the praescutum darker medially. Antennal flagellum yellowish brown; head gray. Fore and middle femora blackened, the basal fifth yellowish; posterior femora yellow with about the distal third dark brown. Halteres with darkened knobs. Wings whitish subhyaline, the costal and apical portions infuscated; usually without a darkened seam along vein Cu_1 in cell *M*. Abdomen brownish yellow, with a dark subterminal ring (♂). Male hypopygium with the aedeagus a very flattened, compressed black blade (Fig. 46, H). ♂. L. 6.5-8 mm.; w. 8-9 mm. ♀. L. 10-11 mm.; w. 10-11 mm.

(June) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich. and Alta.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Putnam, June 15, 1933 (C. P. A.).

Possibly not distinct from *terrae-novae*, which is still known only from the female sex.

L. (*Phylidorea*) **similis** Alex. (Fig. 46, I).
1911. *Limnophila similis* Alexander; Psyche, 18: 195-196.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 4 (wing), fig. 8 (hyp.); 1911. Alexander, Cfls. N. Y., 1, pl. 39, fig. 129 (wing); 1919.

General coloration dark brown, sparsely pruinose, the sides of mesonotum sometimes brightened. Antennal flagellum yellow. Knobs of halteres darkened. Wings yellowish or whitish subhyaline, with a restricted brown pattern, including the costal and apical portions, and

narrow seams along the cord and vein Cu_1. Abdomen dark reddish brown, without a blackened subterminal ring. Male hypopygium (Fig. 46, I) with the aedeagus small and weak, not heavily sclerotized, about as long as its subtending apophyses: basal gonapophyses with the lateral arms slender. ♂. L. 7.5 mm.; w. 9 mm. ♀. L. 8-9 mm.; w. 10-10.5 mm.

(June, July) Ont., Que., Mass., N. Y.

L. (*Phylidorea*) **siouana** Alex. (Fig. 46, J).
1929. *Limnophila* (*Phylidorea*) *siouana* Alexander; Bull. Brooklyn Ent. Soc., 24: 188-189.

Belongs to the *platyphallus* group; closely allied to *novae-angliae*, differing especially in the structure of the male hypopygium (Fig. 46, J). Gonapophyses elongated, strongly bent beyond midlength into a long curved spine, with a small spur at bend. ♂. L. 6-6.5 mm.; w. 5.8-6.5 mm. ♀. L. about 6.5 mm.; w. about 6.7 mm.

(Late May) Ia.

L. (*Phylidorea*) **subcostata** (Alex.) (Fig. 46, K).
1911. *Phylodorea subcostata* Alexander; Can. Ent., 43: 288-289.

Fig.—Alexander, Cfls. N. Y., 1, pl. 40, fig. 149 (wing); 1919.

General coloration black, heavily dusted with gray, thinner and sometimes leaving blackish stripes visible on praescutum. Antennae black throughout; head heavily gray-dusted. Halteres yellow. Legs black, the femoral bases conspicuously yellow, more narrowly so on the fore legs. Wings subhyaline, the stigma darker; wing base and vein *Sc* brighter yellow. Abdomen brownish black. Male hypopygium (Fig. 46, K) with the tergal region slightly produced medially; basistyles stout; outer dististyle slender, unequally bifid at tip; aedeagus elongate; gonapophyses terminating in many small spinous points. ♂. L. 6-6.5 mm.; w. 5.5-7 mm. ♀. L. 6-7.5 mm.; w. 5-6.5 mm.

(May-early July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich.

Connecticut.—Hartland, June 8, 9, 1929 (C. P. A.); Kent Falls, May 31, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P.A.).

L. (*Phylidorea*) **terrae-novae** Alex.
1916. *Limnophila terrae-novae* Alexander; Journ. N. Y. Ent. Soc., 24: 123.
1920. *Limnophila adjuncta* Dietz; Can. Ent., 52: 6-7.

Figs.—Alexander, *Ibid.*, pl. 8, fig. 7 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 39, fig. 130 (wing); 1919.

Belongs to the *platyphallus* group. Body even darker colored than *platyphallus*. Legs dark brown. Wings more heavily patterned, including a dark seam in cell *M* adjoining vein Cu_1. The male sex is unknown, but presumably has a hypopygium not unlike that of *platyphallus*. ♀. L. 9.5-11.3 mm.; w. 9.2-11.4 mm.

(July) (Nfd.)

Subgenus **Limnophila** Macquart

The subgenus *Limnophila*, as here restricted, includes only six local species forming a very loose aggregation. Of these species, *albipes* and *niveitarsis* form one group, but the remaining species are so different among themselves that it is difficult to point out relationships. It is probable that the only local species that is strictly consubgeneric with the genotype of *Limnophila* is *irrorata* Johnson. The adult flies of *albipes* and *niveitarsis* may be swept from rank vegetation in shaded gorges and along minor mountain streams; *laricicola* and *poetica* are characteristic bog-inhabiting species; *brevifurca* frequents wet places in woods, alder swamps, and similar situations; *irrorata* inhabits the southern gum swamps, where it rests on the rich marsh vegetation. Although nothing conclusive seems to be known concerning the subject, it seems highly probable that the early stages of all of the included species above mentioned will be found to occur in rich organic earth in and near the haunts of the adult flies.

Key to Species

1. Wings yellowish subhyaline, with an abundant irrorate brown pattern that includes small, transverse, brown dashes in all the cells; legs yellow, the tips of the femora and tibiae abruptly blackened. .... **irrorata**
   Wings unmarked, except for the stigmal cloud, and, in cases (*poetica*), restricted clouds at origin of *Rs* and along the cord; femora and tibiae not abruptly tipped with black 2
2. Wings with cell M_1 very small, from one-third to one-fourth the length of its petiole (Fig. 44, D) .... **brevifurca**
   Wings with cell M_1 of normal size, subequal in length to, or only a trifle shorter than, its petiole (Fig. 44, C, E) 3
3. Posterior tarsi extensively snowy-white 4
   Posterior tarsi not whitened, similar in color to the other tarsi 5
4. General coloration of thorax shiny reddish yellow to brown, the mesonotum sometimes more infuscated medially; pleura clearer yellow; *Sc* short, ending about opposite two-thirds to three-fourths the length of *Rs* (Fig. 44, C) **albipes**
   General coloration of thorax black, heavily gray pruinose; *Sc* longer, ending about opposite the fork of *Rs* .... **niveitarsis**
5. Wings unmarked, except for the darker stigmal area; *Rs* relatively short, less than two times the length of *m-cu*, angulated but not spurred at origin; ground-color of head gray .... **laricicola**
   Wings with faint dark clouds along cord and at origin of *Rs*; *Rs* long, more than twice the length of *m-cu*, angulated and usually spurred at origin (Fig. 44, E); ground-color of head yellow to brownish yellow ...... **poetica**

Limnophila (*Limnophila*) **albipes** Leond. (Figs. 44, C; 45, O).
1913. *Limnophila albipes* Leonard; Ent. News, 24: 248-249.

Figs.—Leonard, *Ibid.*, 24: 248, text-figure (wing); 1913. Alexander, Cfls. N. Y., 1, pl. 38, fig. 119 (wing); 1919.

Body not or scarcely pruinose. Antennae (♂) elongate, approximately one-half as long as body, of ♀ shorter, extending to base of abdomen. Femora obscure yellow, the tips weakly darkened; tibiae and tarsi brown, the posterior tarsi snowy-white. Wings (Fig. 44, C) subhyaline, the stigma a little darker; Sc_2 at tip of Sc_1; R_{2+3+4} long, nearly twice the length of *m-cu*, the latter at or beyond midlength of cell *1st* M_2. Abdominal tergites dark brown, the sternites paler, in

4 with a narrow black subterminal ring; hypopygium yellow. Male hypopygium (Fig. 45, O) with the outer dististyle bifid at apex, bearing an acute lateral spur on outer margin at about three-fourths the length; inner dististyle short and broad, its apex nearly truncate, blackened; outer gonapophyses bearing a dense brush of long yellow setae on disk; inner gonapophyses slender, microscopically toothed before apex. ♂. L. 4.5-5 mm.; w. 5.5-5.8 mm. ♀. L. 6.5-7 mm.; w. 5.8-6 mm.

(July) Vt., Mass., N. Y., N. J., southw. to S. C.

L. (*Limnophila*) **brevifurca** O. S. (Fig. 44, D).
1859. *Limnophila brevifurca* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 237.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 14, fig. 6 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 38, fig. 125 (ven.); 1919.

General coloration of mesonotum brownish gray, the praescutal stripes ill-defined; pseudosutural foveae and tuberculate pits black. Antennae short in both sexes. Legs brownish yellow, the tips of femora and tibiae darkened. Wings with a faint brownish tinge, the stigma a trifle darkened (Fig. 44, D); *Rs* long; R_{2+3+4} short, less than *m-cu*; R_2 about one-third to two-fifths R_{1+2}. In certain specimens cell M_1 may be lost in one or even in both wings. Abdomen pale brown, darker laterally, with a dark subterminal ring; hypopygium yellow. Male hypopygium with the basistyles long and slender; outer dististyle slender, bifid at apex; interbases terminating in oval heads. ♂. L. 5-6 mm.; w. 5.5-6.5 mm. ♀. L. about 6-6.5 mm.; w. 6.5-7 mm.

(May, June; rarely in Autumn) Que., N. B., Me., N. H., Vt., Mass., westw. to Mich., southw. to S. C.

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Norfolk, May 21, 1916 (W. L. M.); May 16, 1931, May 31, 1931, June 9, 1929, June 12, 1931 (C. P. A.); Kent Falls, May 31, 1931 (C. P. A.); N. Branford, May 12, 1933 (M. P. Z.); Riverton, May 17, 1931, May 30-31, 1931, June 8, 1929 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); Winsted, May 16, 1931 (C. P. A.).

L. (*Limnophila*) **irrorata** Johns. (Fig. 45, P).
1909. *Limnophila irrorata* Johnson; Proc. Boston Soc. Nat. Hist., 34: 127-128.
1916. *L. irrorata* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 531-532.

Figs.—Johnson, *Ibid.*, 34, pl. 16, fig. 17 (wing); 1909. Alexander, Cfls. N. Y., 1, pl. 39, fig. 133 (wing); 1919.

General coloration of mesonotum dark brown, with a sparse yellow pollen, leaving vague darker streaks. Antennae short in both sexes, black throughout. Halteres brownish yellow, the knobs dark brown. Legs conspicuously hairy; outer tarsal segments blackened. Wings with larger dark areas at origin of *Rs*, along cord and at ends of veins R_{1+2} and R_3; R_{2+3+4} short to very short, in most cases about one-half *m-cu*; R_{1+2} and R_2 subequal; cell M_1 about equal to its petiole; *m-cu* beyond midlength of cell *1st* M_2. Abdominal tergites

brownish yellow, narrowly darkened laterally; outer segments more infuscated; hypopygium brownish yellow. Male hypopygium (Fig. 45, P) with the outer dististyle a heavily chitinized curved hook, the apex simple; at about the basal third, the style bears a small lateral branch; inner dististyle more or less hammer-shaped. ♂. L. 7.6-7.8 mm.; w. 7-7.3 mm. ♀. L. about 8 mm.; w. 7-7.5 mm.

(July, Aug.) N. J., southw. to w. Fla.

L. (*Limnophila*) **laricicola** Alex. (Fig. 45, Q).
1912. *Limnophila laricicola* Alexander; Psyche, 19: 167.

Figs.—Alexander, *Ibid.*, 19, pl. 13, fig. 4 (wing); 1912. Alexander, Cfls. N. Y., 1, pl. 38, fig. 120 (wing); 1919.

General coloration of mesonotum polished rusty-red, without markings. Antennae (♂) elongate, if bent backward extending to beyond base of abdomen; flagellar segments swollen on ventral face, black, the incisures a little paler. Halteres with darkened knobs. Legs obscure yellow, the outer tarsal segments darkened. Wings with a strong yellow tinge, the stigma a trifle darker; Sc_1 ending about opposite *r-m*; R_{2+3+4} long, exceeding *m-cu*; R_{1+2} and R_2 subequal; *m-cu* at or beyond midlength of cell *1st* M_2. Abdomen conspicuously hairy, brownish yellow, darkened laterally; in ♂ with a dark brown subterminal ring; hypopygium large; obscure yellow. Male hypopygium (Fig. 45, Q) with the tergite produced into two slender lobes that are separated by a broad U-shaped notch; outer apical angle of basistyle produced into a chitinized spine; outer dististyle conspicuously bifid, one arm a slender chitinized spine; inner dististyle elongate, expanded outwardly, shallowly bifid at apex; aedeagus elongate. ♂. L. 5.5-6 mm.; w. 5.5-6.5 mm. ♀. L. 7.5-8 mm.; w. 6.5-7 mm.

(June) Vt., Mass., N. Y., westw. to Mich., southw. to Va. and Tenn.

Connecticut.—Phoenixville, June 14, 1933 (C. P. A.); Putnam, June 15, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.).

The general appearance, especially of the female, is quite like that of a small, inconspicuous species of *Phylidorea*, such as *novae-angliae*, and care must be taken in the determination. The male hypopygium is very distinctive.

L. (*Limnophila*) **niveitarsis** O. S. (Fig. 45, R).
1869. *Limnophila niveitarsis* Osten Sacken; Mon. Dipt. N. Amer., 4: 209-210.

Fig.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 118 (wing); 1919.

Praescutum without evident praescutal stripes; tuberculate pits lacking. Antennae (♂) very long, if bent backward extending to near two-thirds the length of abdomen; scape short, black; flagellum dark brown, the segments with a delicate, erect, pale pubescence; antennae in ♀ shorter, extending about to base of abdomen. Head light gray. Halteres yellow. Legs with femora and tibiae obscure brownish yellow, the tips darkened; tarsi dark brown, the posterior tarsi snowy-white, especially the setae. Wings with a faint brownish

tinge, the stigma darker; R_{1+2} and R_2 subequal; R_{2+3+4} about one-third to one-half longer than *m-cu;* petiole of cell M_1 about one-half the cell; cell *1st* M_2 relatively small. Abdominal tergites weakly bicolorous, brownish black, the apices more reddish brown; sternites uniformly yellow; a narrow black subterminal ring in ♂; hypopygium obscure yellow. Male hypopygium (Fig. 45, R) with the basistyle having the mesal margin crenate; outer face of basistyle, near apex, with a group of large coarse setae; outer dististyle unusually compressed, narrowed to the bidentate blackened apex; inner dististyle short, roughly triangular in outline, the inner portion with a few microscopic spines; gonapophyses appearing as yellow decussate blades, their outer margins microscopically toothed; aedeagus short. ♂. L. 5.5-6.5 mm.; w. 6.5-8 mm. ♀. L. 7-7.5 mm.; w. 7.5-8 mm.

(June) Mass., N. Y., southw. to Md., Ind., N. C. and Tenn. (Transition).

L. (*Limnophila*) **poetica** O. S. (Figs. 44, E; 45, S).
1869. *Limnophila poetica* Osten Sacken; Mon. Dipt. N. Amer., 4: 207-208.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 18, fig. 3 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 38, fig. 116 (wing); 1919. Dickinson, Cfls. Wisc., p. 204, fig. 100 (wing); 1932.

General coloration of mesonotum yellowish to brownish yellow, subnitidous; tuberculate pits lacking; pseudosutural foveae small; pleura yellow, somewhat darker in female. Antennae (♂) elongate, if bent backward extending to about opposite one-third the length of the long abdomen; flagellar segments beyond first black; antennae in ♀ shorter, extending about to root of halteres. Head with center of vertex darkened. Halteres with darkened knobs. Legs with femora brownish yellow, the tips dark brown to black; tibiae yellowish brown, the tips, together with all tarsi, blackened; legs of female shorter and more conspicuously hairy. Wings (Fig. 44, E) yellowish, with a very restricted brown pattern, including the stigma and narrow seams at origin of *Rs* and along cord; wings of female darker and somewhat reduced in size. Abdomen (♂) elongate, yellow, with a narrow blackened subterminal ring. Male hypopygium (Fig. 45, S) with the basistyles bearing a truncated lobe on mesal face near base; outer dististyle slender, narrowed to the small bidentate apex; gonapophyses appearing as long sinuous horns, each with a small lateral branch at near midlength. ♂. L. 9-9.5 mm.; w. 8.5-9 mm. ♀. L. 8.5-9 mm.; w. about 8 mm.

(May-Aug., especially June) Ont., Que., northwestw. to Alta. and Alaska, westw. to Mich., Wisc. and Ill., southw. to Mass. (Hudsonian, Canadian).

Shannonomyia Alexander

1929. *Shannonomyia* Alexander; Dipt. Patagonia and S. Chile, 1: 142-143.

A single species, of discordant affinities, comes within the present faunal limits. In its general appearance and venation, this fly, *S.*

lenta, much resembles a species of *Pilaria* or *Limnophila* (*Phylidorea*) but is equally out of place in either group. The antennae have verticils of normal size and number. The chief tendencies of venation are in the short *Rs*, with *Sc* ending shortly before its fork; position of R_2 near the fork of the long straight R_{2+3+4} which is in direct alignment with *Rs*; cell M_1 lacking (Fig. 44, F). The adult flies occur on vegetation in open shaded situations, usually near water. The early stages are unknown.

Shannonomyia lenta (O. S.) (Fig. 44, F).
1859. *Limnophila lenta* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 241.

Figs.—Alexander, Psyche, 18, pl. 16, fig. 1 (ven.); 1911. Alexander, Cfls. N. Y., 1, pl. 40, fig. 152 (ven.); 1919.

General coloration of thorax pale brownish yellow to ochreous, without markings; pleura with a vague pruinosity. Antennae (♂) relatively long, if bent backward extending about to root of halteres; basal segments yellowish, the flagellum chiefly brown. Head gray, more silvery in front. Halteres and legs yellow. Wings (Fig. 44, F) with a grayish yellow tinge, the base and costal region clearer yellow; stigma and vague clouds along cord and outer end of cell *1st* M_2 pale brown; veins pale. Abdomen obscure yellow, with a narrow darkened subterminal ring. ♂. L. 5-5.5 mm.; w. 5.5-6.5 mm. ♀. L. 7-8 mm.; w. 7-7.5 mm.

(May-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Mich. and Ill., southw. to Ga. and Tenn.

Connecticut.—East River, July 6, 1910 (Ely); Granby, June 8, 1929 (C. P. A.); Hamden, July 13, 1932 (P. G.); Kent Falls, June 12-13, 1931, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 6, 1928 (G. C. C.); Riverton, July 23, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Tunxis State Park, July 23, 1931 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.); Westford, June 14, 1933 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

A second form of the species is described herewith.

Shannonomyia lenta gaspeana subsp. nov.

General coloration of body darker brown, more or less pruinose; median region of praescutum with a darker brown stripe. Antennal flagellum dark brown. Knobs of halteres infuscated. Tips of tibiae narrowly darkened. Wings with the veins darker; veins R_3 and R_4 more divergent, cell R_3 wide at margin. Abdomen, including hypopygium, dark brown.

Holotype, ♂, Ruisseau Castor, N. Gaspé, Que., June 27, 1931 (*C. P. Alexander*); in author's collection.

It is probable that additional material will show that this fly deserves full specific rank.

The status of *S. congenita* (Dtz.) (Trans. Amer. Ent. Soc., 47: 257; 1921) is still uncertain but seems to represent a dark form of *lenta*. The antennae are described as being darker brown than in the typical form and the median region of the ninth tergite of the male

hypopygium is stated to project acutely. The other genitalic characters described seem to be more apparent than real. (June, July) Pa.

Pilaria Sintenis

1888. *Pilaria* Sintenis; Sitzber. Nat.—Ges. Dorpat, 8:398.
1919. *Eulimnophila* Alexander; Cornell Univ., Agr. Expt. Sta., mem. 25:917.

The genus *Pilaria* includes a small number of local species that present a distinctive appearance as a group, yet are rather difficult of specific separation. The essential features of venation lie in the relatively short *Sc*, which ends at from two-thirds to beyond four-fifths the length of *Rs;* the very long *Rs*, which is in alignment with R_{2+3+4} and usually also with R_4; the position of R_2 at or close to the fork of R_{2+3+4}, the feature varying somewhat in all species, where the element may lie before, opposite or beyond this fork in different specimens; the usually long fusion of R_{1+2}, shortest in species such as *stanwoodae;* and the transverse alignment of the three elements constituting the anterior cord (Fig. 44, G, H). In the present fauna, there occur a few species with elongate antennae in the male, together with others having the organ short in both sexes, the latter group having unusually long conspicuous verticils on all flagellar segments, the former group with these verticils in male becoming long and conspicuous on the outer segments. Likewise there occur species having cell M_1 present, while a second group of forms have lost the cell by the fusion of adjoining veins. The adults of *osborni*, *stanwoodae* and *vermontana* are characteristic inhabitants of bogs; *quadrata* and *recondita* of helophytic associations; the other species in rank shaded situations, usually near streams. The immature stages are spent in rich organic earth. As was done with *Pseudolimnophila*, Edwards (1938) has placed this group as a subgenus of *Limnophila* Macquart. In this arrangement I cannot agree, since the immature stages of both groups differ widely from the condition found in *Limnophila*.

Key to Species

1. Wings with cell M_1 present (Fig. 44, H) 2
   Wings with cell M_1 lacking (Fig. 44, G) 6
2. Thoracic dorsum chiefly dark brown to black; wings narrow, with a long basal petiole, the stigma usually very distinct; antennae (♂) elongate, exceeding one-half the length of body .... **tenuipes**
   Thoracic dorsum reddish brown to yellowish brown; wings broader, with a shorter basal petiole and with stigma pale brown to virtually lacking; antennae short in both sexes, except in *vermontana* where the thoracic dorsum is polished reddish yellow 3
3. Mesonotum polished reddish yellow to reddish brown 4
   Mesonotum opaque yellow to brownish yellow (*imbecilla*) 5
4. Wings strongly tinged with brown; head brown; antennae short in both sexes .... **recondita**
   Wings only slightly infumed; head blackish, pruinose; antennae (♂) elongate, if bent backward extending to beyond base of abdomen ..... **vermontana**
5. Size larger (wing, ♂, over 7 mm.); head light gray .... **imbecilla imbecilla**
   Size small (wing, ♂, about 6-6.5 mm.); head yellowish. . **imbecilla illinoiensis**

6. Thoracic dorsum brownish black, the lateral margins yellow; pleura yellow; wings with distinct stigma; veins R_3 and R_4 extending generally parallel for most of their length, only gently divergent, cell R_2 at margin nearly as wide as cell R_3; antennae (♂) elongate, exceeding one-half the length of body .... **edwardi**
   Thoracic dorsum not differing conspicuously from the ground-color of pleura; wings with stigma pale brown or indistinct; veins R_3 and R_4 strongly divergent, cell R_2 at margin being about one-half of cell R_3 or a trifle more; antennae short in both sexes, if bent backward extending about to wing-root 7
7. General coloration of thorax blackish, gray pruinose .... **quadrata**
   General coloration of thorax yellowish to reddish brown 8
8. Thoracic pleura with a broad black longitudinal stripe .... **osborni**
   Thoracic pleura pale yellow, immaculate .... **stanwoodae**

Pilaria edwardi (Alex.)

1916. *Limnophila edwardi* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 533.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 45 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 40, fig. 156 (wing); 1919.

Head blackish. Femora and tibiae light brown, the tips weakly darkened. Wings relatively narrow, very faintly tinged with brown, the stigma darker brown, hairy. Abdomen dark brown, the hypopygium more yellowish. ♂. L. 7.2 mm.; w. 8 mm.; antenna, about 5 mm.

(June) N. Y.

Known only from the unique type. It seems very possible that this may prove to be an abnormal specimen of *tenuipes*.

P. imbecilla imbecilla (O. S.)

1859. *Limnophila imbecilla* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 237.

Figs.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 122 (wing); 1919. Dickinson, Cfls. Wisc., p. 206, fig. 103 (wing); 1932.

General coloration of thorax pale brown to yellowish brown, without stripes; pseudosutural foveae pale. Antennae with scape and pedicel dark brown, basal flagellar segments yellow, the outer segments blackened. Legs obscure yellow. Wings yellowish gray, the stigma feebly darkened, the costal region clearer yellow; R_2 just beyond fork of R_{2+3+4}. Abdomen pale, darkened outwardly, with a subterminal brown ring; hypopygium yellow. ♂. L. 7-8 mm.; w. 7-8.5 mm. ♀. L. about 8 mm.; w. 7.5-8 mm.

(June, July) Ont., Que., Mass., N. Y., westw. to Wisc. and Ill., southw. to Ind. and Tenn.

P. imbecilla illinoiensis (Alex.)

1920. *Limnophila* (*Eulimnophila*) *imbecilla illinoiensis* Alexander: Can. Ent., 52: 226.

Very close to the typical form, differing in the small size and yellowish head, with the antennal scape pale yellow. ♂. L. 6 mm.; w. 6-6.5 mm.

(June) Ind., Ill., Ky., Tenn.

P. osborni (Alex.)

1914. *Limnophila osborni* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1914: 596-597.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 6 (wing); 1914. Alexander, Cfls. N. Y., 1, pl. 40, fig. 154 (wing); 1919. Dickinson, Cfls. Wisc., p. 206, fig. 104 (wing, as *recondita*), 1932.

General coloration of mesonotum rich reddish brown, the posterior sclerites slightly pruinose; lateral portions of praescutum and scutum brownish black; pleura reddish yellow with a black longitudinal stripe. Femora yellowish brown, the tips weakly darkened. Wings with a brownish tinge, produced chiefly by vague seams along the veins; stigma a little darker; R_2 close to fork of R_{2+3+4}. Abdominal tergites brown, becoming still darker on outer segments; a blackened subterminal ring; hypopygium obscure yellow. ♂. L. 6.3-6.5 mm.; w. 7.4-7.5 mm.

(Late Aug., Sept.) Me., westw. to Wisc. and the Rocky Mts. of Wyo. and Colo. This species is closely allied to the European *P. meridiana* (Staeger).

P. quadrata (O. S.) (Fig. 44, G).

1859. *Limnophila quadrata* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 241.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 9 (wing); 1869. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 9, fig. 18; pl. 10, fig. 34 (hyp.); 1904. Alexander, Psyche, 18, pl. 16, fig. 2 (ven.); 1911. Alexander, Cfls. N. Y., 1, pl. 40, fig. 153 (wing); 1919.

Praescutal stripes lacking or ill-defined. Antennae black throughout. Femora obscure yellow, passing into brown at tips. Wings (Fig. 44, G) with a brownish yellow suffusion, the base and costal region clearer yellow; stigma pale; Sc_1 ending about opposite two-thirds Rs; R_2 close to fork of R_{2+3+4}. Abdomen black, sparsely pruinose; hypopygium rusty-red. ♂. L. 7-8 mm.; w. 8-9 mm. ♀. L. 10-11 mm.; w. 9-10 mm.

(May-early Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich. and Ia., southw. to Ga., n. Fla. and Tenn.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Hamden, June 11, 1914 (W. E. B.); Natchaug State Forest, June 14, 1933 (C. P. A.); New Haven, May 31, 1929 (R. B. F.); Putnam, June 15, 1933 (C. P. A.); Southington, May 28, 1930 (R. B. F.); Tunxis State Park, June 12, July 23, 1931 (C. P. A.); Tyler Lake, June 13, July 23, 1931 (C. P. A.); Winsted, June 10, 1928 (R. B. F.).

P. recondita (O. S.)

1869. *Limnophila recondita* Osten Sacken; Mon. Dipt. N. Amer., 4: 212-213.

Figs.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 123 (ven.); 1919. Dickinson, Cfls. Wisc., p. 206, fig. 105 (wing, as *osborni*); 1932.

Antennae obscure yellow, the outer segments darkened. Halteres and legs obscure yellow. Wings with stigma scarcely differentiated; Sc_1 ending shortly before to nearly opposite the fork of Rs; R_2 some distance beyond fork of R_{2+3+4}; cell M_1 deep. Abdomen, including

the hypopygium, reddish brown. ♂. L. 8-10 mm.; w. 9-11 mm. ♀. L. 9-10 mm.; w. 9-10 mm.

(June-Aug.) Que., N. B., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., Ill., Minn. and Mo., southw. to Fla., Ala., La. and Tenn.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Putnam, June 12, 1905 (H. L. V.), June 15, 1933 (C. P. A.); Tyler Lake, June 13, July 23, 1931 (C. P. A.).

In Florida, there occurs a more southern species or subspecies, *arguta* Alexander, smaller, with narrower and less infumed wings.

P. stanwoodae (Alex.)

1914. *Limnophila stanwoodae* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1914: 595-596.

Figs.—Alexander, *Ibid.*, pl. 25, fig. 5 (wing); 1914. Alexander, Cfls. N. Y., 1, pl. 40, fig. 155 (wing); 1919.

General coloration of thorax yellow to pale brownish yellow; the praescutum unmarked. Antennae with scape pale, pedicel and flagellum brownish black. Head grayish brown. Femora obscure yellow, the tips narrowly darkened. Wings with a yellow suffusion, the stigma vaguely darkened; Sc_1 ending about opposite four-fifths the length of Rs, R_2 some distance beyond fork of R_{2+3+4}, subequal to or only a little shorter than the unusually short R_{1+2}. Abdomen yellowish brown, with a dark brown subterminal ring; hypopygium yellowish. ♂. L. 6-7.5 mm.; w. 7-8 mm. ♀. L. 6.8-7.5 mm.; w. 6.8-8 mm.

(June) Me., N. H., Vt., Mass., N. Y., southw. to S. C.

Connecticut.—Manitic Lake, June 8-9, 1929 (C. P. A.); Montville, June 12, 1929 (W. E. B.); Natchaug State Forest, June 14, 1933 (C. P. A.); Phoenixville, June 14, 1933 (C. P. A.); Putnam, June 15, 1933 (C. P.A.); Stafford Springs, June 14, 1933 (C.P. A.).

P. tenuipes (Say) (Fig. 44, H).

1823. *Limnobia tenuipes* Say; Journ. Acad. Nat. Sci. Philadelphia, 3: 21.

1869. *Limnophila tenuipes* Osten Sacken; Mon. Dipt. N. Amer., 4: 210-211.

Figs.—Alexander, Cfls. N. Y., 1, pl. 38, fig. 121 (wing); 1919. Dickinson, Cfls. Wisc., p. 206, fig. 102 (wing); 1932.

Lateral margins of praescutum broadly yellow, the posterior sclerites slightly more pruinose; pleura yellow. Antennae with basal segments pale, flagellum black; segments cylindrical, with verticils that are shorter than segments, becoming more elongate and evident on outer segments; in female, antennae shorter, extending to just beyond base of abdomen, with verticils conspicuous on all segments. Head black, sparsely pruinose. Legs brownish yellow to brown. Wings (Fig. 44, H) faintly suffused with dusky; R_2 variable in position but close to fork of R_{2+3+4}. Abdomen dark brown, the sternites paler; hypopygium yellow. ♂. L. 7.5 mm.; w. 7 mm. ♀. L. 8-9.5 mm.; w. 8-9 mm.

(Late May-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Wisc., Ia., Mo. and Kan., southw. to Fla., Ga., Miss. and Tex.

Connecticut.—East River, Sept. 1910 (Ely); Salisbury, Sept. 12, 1928 (C. P. A.); Union, Aug. 17, 18, 1928 (C. F. C.).

P. vermontana Alex.
1929. *Pilaria vermontana* Alexander; Ent. News, 40: 47-48.

Antennae dark brown throughout. Head grayish brown. Femora obscure yellow, the tips darkened. Wings with a pale brown tinge, the hairy stigma only a trifle darker; Sc_1 ending about opposite four-fifths the length of Rs; R_2 close to fork of R_{2+3+4}; R_{1+2} long; cell M_1 present, subequal to or longer than its petiole. Abdominal tergites dark brown; sternites paler; hypopygium obscure yellow. ♂. L. 7.5-8.5 mm.; w. 8-9 mm. ♀. L. 8 mm.; w. 9.5 mm.

(June-early Aug.) Vt. to Ct.

Connecticut.—Manitic Lake, June 8-9, Aug. 6, 1929 (C. P. A.); Phoenixville, June 14, 1933 (C. P. A.).

Ulomorpha Osten Sacken

1869. *Ulomorpha* Osten Sacken; Mon. Dipt. N. Amer., 4: 232.

Ulomorpha is unquestionably closely allied to *Pilaria* despite the distinctive appearance given by the conspicuously hairy wings and the sessile or subsessile cell R_3. The adult flies are usually found by being swept from rich herbaceous vegetation in low, shaded areas. The immature stages live in rich organic earth in woods.

Key to Species

1. General coloration of body reddish yellow to pale brown .... **pilosella**
   General coloration of body polished black .... **rogersella**

Ulomorpha pilosella (O. S.) (Fig. 44, I).
1859. *Limnophila pilosella* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 242.

Fig.—Alexander, Cfls. N. Y., 1, pl. 41, fig. 163 (wing); 1919.

Wings tinged with brownish, stigma lacking. ♂. L. 5.5-6 mm.; w. 7-7.5 mm. ♀. L. 8-8.5 mm.; w. 7.5-8 mm.

(May-July) Que., Me., N. H., Vt., Mass., N. Y., westw. to Mich. and Ind., southw. to N. C., S. C. and Tenn.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.); Union, June 14, 1933 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

U. rogersella Alex.
1929. *Ulomorpha rogersella* Alexander; Ent. News, 40: 48-49.

Ventral thoracic pleurites reddish yellow. Fore femora extensively blackened, the remaining femora yellow. Wings yellowish, the veins broadly seamed with darker. ♂. L. about 5.5 mm.; w. 6 mm. ♀. L. about 8 mm.; w. 7.5 mm.

(June) N. C. and S. C. (mts.), southw. to n. Fla.

6. Subtribe **Hexatomaria**

The subtribe Hexatomaria includes a single genus *Hexatoma*, with three subgenera, of which two occur in our fauna. The chief mor-

phological characters lie in the reduction in number of antennal segments, correlated with a tremendous elongation in this organ in the males of several species, and the presence of a strong protuberance or tubercle on the vertex. As regards venation, the reduction in number of branches of Media is very striking (Fig. 44, J-N), there being species with all four branches, including cell M_1 present; many others with only three branches, and cell M_1 lost by fusion of adjacent veins; while in the subgenus *Hexatoma*, cell *1st* M_2 is open by the entire atrophy of m and both sections of vein M_3, there being but two branches of the vein attaining the wing margin. In the chiefly Palaearctic subgenus *Cladolipes* Loew, the radial field is similarly reduced, cell R_3 being lost by the fusion of enclosing veins, a condition that is presaged by the local *Hexatoma* (*Hexatoma*) *megacera*. The species of the subgenus *Hexatoma* and some closely allied *Eriocera* have the valves of the ovipositor short and only feebly sclerotized, while the other and more numerous species have these valves unusually long and acutely pointed.

The adult flies of certain species of *Eriocera* are among the most rapid-flying and active of all known Tipulidae, sometimes appearing in vast swarms near the banks of major streams and rivers. Their larvae live in water or saturated soil and are intensely carnivorous. When ready to pupate, they come to sandy soil at the bank of the stream. The larvae of *Hexatoma* (*Eriocera*) *albitarsis* (O. S.) and *H.* (*E.*) *brevioricornis* Alex., formerly held to belong to a separate subgeneric group, *Penthoptera*, frequent rich organic mud in wooded swamps or along densely shaded streams.

Hexatoma Latreille

1809. *Hexatoma* Latreille; Gen. Crust. et Ins., 4:260.
1818. *Anisomera* Meigen; Syst. Beschr. Zweifl. Ins., 1:210.

Key to Subgenera

1. Wings with cell *1st* M_2 open; two branches of M reach the margin (Fig. 44, J, K) .... **Hexatoma**
   Wings with cell *1st* M_2 closed; three or four branches of M reach the margin (Fig. 44, L, M, N) .... **Eriocera**

Subgenus **Hexatoma** Latreille

The subgenus *Hexatoma*, in our fauna, includes but two species, one of which may prove not to be regional. The extreme reduction of the medial field is parallelled only by a subgenus of *Limonia* Meigen (*Alexandriaria* Garrett). The antennae are reduced to but six evident segments, with an additional minute "button", in the male, and with the sixth segment of the female sometimes vaguely divided by incomplete constrictions. The adult flies rest on vegetation along the banks of large creeks having sandy margins, wherein may be found the early stages.

Key to Species

1. Cell R_3 of wings very small, subequal to or shorter than its petiole (Fig. 44, J); *Rs* and its anterior branch without macrotrichia; antennae (♂) long, approximately one-half longer than the entire body .... **megacera**

Cell R_3 of wings large, more than twice as long as its petiole (Fig. 44, K); abundant macrotrichia on *Rs* and its anterior branch (R_{2+3+4}, R_{3+4}, R_3 and R_4); antennae (♂) short, if bent backward scarcely attaining the wing-root .... **microcera**

Hexatoma (*Hexatoma*) **megacera** (O. S.) (Fig. 44, J).
1859. *Anisomera megacera* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 242.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 12 (wing); 1869. Williston, Man. N. Amer. Dipt., Ed. 3: 84, fig. 25, sub 13 (ven.); 1908, as *neglecta*. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 26, fig. 2 (ven.); 1908. Alexander, Cfls. N. Y., 1: 850, fig. 125, G (ant. ♂), H (ant. ♀); pl. 37, fig. 112 (wing); 1919.

General coloration of thorax brownish gray, the praescutum with three darker brown stripes; pleura brown. Antennae of female short, not attaining the wing-root. Wings with a brownish tinge, caused especially by somewhat darker seams along veins. Abdomen dark brown. ♂. L. about 5-6 mm.; w. 5-6 mm.; antenna, about 7-9 mm. ♀. L. 6-7 mm.; w. 6-7.5 mm.

(May, June) Que., N. H., Mass., N. Y., westw. to Ind., southw. to Md. and Va.

Connecticut.—Chapinville, May 26, 1904 (W. E. B.); Norfolk, May 31, 1931 (C. P. A.).

H. (*Hexatoma*) **microcera** Alex. (Fig. 44, K).
1926. *Hexatoma microcera* Alexander; Ent. News, 37: 49-50.

General coloration gray, the praescutum with three more blackish stripes. Legs short and stout. Wings faintly tinged with brown. ♂. L. 5.8-6.5 mm.; w. 7.1-8 mm.

Known only from three male specimens in the Vienna Museum, bearing the label "America borealis, 1867." The species has never been re-discovered and may not be regional to the present report.

Subgenus **Eriocera** Macquart

1838. *Eriocera* Macquart; Dipt. Exot., 1: 74.
1863. *Penthoptera* Schiner; Wien. Ent. Monatschr., 7: 220.

The subgenus *Eriocera* is a vast group, best represented in the tropics of both the Old and New Worlds. In the local fauna, it includes about fourteen species, some of which are rather difficult of separation. The character of very elongate antennae in the male sex is very striking, but, unfortunately, is not always correlated with other characters in the female. The various species with such lengthened antennae are often very close to others with the organ short in both sexes (*spinosa*, *brachycera*; *wilsonii*, *aurata*; *longicornis*, *gaspensis*). The adults of several of the species frequent the margins of major streams having sandy margins; *aurata* and *wilsonii* are found in southern swamps and bogs; *brachycera* and *spinosa* are most often to be found flying swiftly over the quiet pools of medium-sized mountain streams; *tristis* occurs in small dancing swarms in similar situations.

Key to Species

1. Cell M_1 of wings present (Fig. 44, L, N) 2
   Cell M_1 of wings lacking (Fig. 44, M) 5
2. Tarsi snowy-white 3
   Tarsi not white 4
3. Wings strongly tinged with brown; antennae (♂) more than half the length of body; first flagellar segment more than three times the length of head. **albitarsis**
   Wings subhyaline or but weakly suffused with darker; antennae of both sexes less than one-half the length of body; first flagellar segment about twice the length of head .... **brevioricornis**
4. Antennae (♂) elongate, approximately three times the body; wings grayish brown; vertical tubercle very prominent .... **spinosa**
   Antennae short in both sexes, extending about to the wing-root or a little beyond; wings darker brown; vertical tubercle low .... **brachycera**
5. General coloration of body yellow or yellowish red 6
   General coloration of body gray, brown or black 7
6. Wings with a weak yellowish tinge, the stigma pale brown; antennae (♂) elongate, about one-half longer than the body; dorso-pleural membrane and a spot on lateral margin of scutum velvety-black .... **wilsonii**
   Wings with a strong brownish yellow suffusion, the stigma conspicuous, dark brown; antennae short in both sexes; in cases a small to nearly obsolete brownish spot on lateral margin of scutum.......... **aurata**
7. Wings with distal section of vein Cu_1 unusually long, nearly twice *m-cu*. **alberta**
   Wings with the distal section of Cu_1 short, subequal to or shorter than *m-cu* 8
8. R_2 far before fork of R_{3+4}, the latter subequal to or longer than R_{1+2}, cell R_3 correspondingly shortened .... **fultonensis**
   R_2 close to or beyond fork of R_{2+3+4}, vein R_{3+4} being obliterated or very short, cell R_3 correspondingly lengthened 9
9. R_2 some distance beyond the fork of R_{2+3+4}, R_{2+3} much longer than R_{1+2}; vein R_4 usually with abundant macrotrichia throughout its length; antennae (♂) elongated; ovipositor with elongate chitinized valves .... **cinerea**
   R_2 close to fork of R_{2+3+4}, R_{2+3} very short or lacking; no macrotrichia on Rs or either of its anterior branches (excepting two or three in some specimens of *gibbosa*); antennae (♂) short, elongate only in ♂ of *longicornis* which has ovipositor with short fleshy valves 10
10. General coloration of thoracic dorsum dark brown or black, without pruinosity; vertical tubercle polished black; wings with a strong blackish suffusion .... **tristis**
    General coloration of thoracic dorsum gray or brownish gray; vertical tubercle opaque, concolorous with remainder of vertex; wings not uniformly suffused with blackish 11
11. Knobs of halteres whitish; wings, especially of males, widest opposite the level of vein *2nd A*; antennae (♂) very elongate (*longicornis*) or short (*gaspensis*); ovipositor with short fleshy valves 12
    Knobs of halteres dark brown; wings widest along the central half of wings or opposite the distal half; antennae short in both sexes; ovipositor with long chitinized valves 13
12. Antennae (♂) very long; wings with Sc long, Sc_1 ending some distance beyond the fork of Rs; size large (wing, ♂, over 10 mm.) ...... **longicornis**
    Antennae short in both sexes; wings with Sc short, Sc_1 ending about opposite the fork of Rs; size small (wing, ♂, under 8 mm.) .... **gaspensis**
13. General coloration of mesonotum and pleura grayish brown, distinctly pruinose .... **gibbosa**
    General coloration of mesonotum and pleura dull dark brown, with only a slight yellowish gray pruinosity .... **fuliginosa**

Hexatoma (*Eriocera*) **alberta** (Alex.)
1930. *Eriocera alberta* Alexander; Bull. Brooklyn Ent. Soc., 25:73-74.

General coloration black, light gray pruinose. Antennae (♀) seven-segmented, black. Halteres with whitish knobs. Wings whitish, with clearly delimited grayish brown seams along cord and other veins; *Rs* angulated and spurred at origin; cell R_3 deep, parallel-sided for more than two-thirds the length; cell *1st* M_2 rectangular; *m-cu* at or close to fork of *M*. Ovipositor with fleshy valves. ♀. L. about 7 mm.; w. 9.2 mm.

(June) Alta.

H. (*Eriocera*) **albitarsis** (O. S.)
1869. *Penthoptera albitarsis* Osten Sacken; Mon. Dipt. N. Amer., 4: 257-258.

Figs.—All figures recorded under *albitarsis* pertain to the species described later as *brevioricornis*.

Mesonotum brownish black, with a sparse blue-gray pruinosity, to produce a plumbeous appearance, the praescutum sometimes with weakly indicated stripes; pleura abruptly pale yellow. Antennae (♂) six-segmented with an additional microscopic terminal "button". Head light gray. Wings with a brownish tinge, the small stigma very pale brown; *m-cu* beyond midlength of cell *1st* M_2, exceeding the distal section of Cu_1, the latter in alignment with its basal section. Abdominal tergites dark brown, the sternites and hypopygium yellowish. ♂. L. about 6-7 mm.; w. 7-8 mm.

(July) Pa., w. to Ia., southw. to S. C., Ga. and nw. Fla.

I am herewith restricting the name *albitarsis* to the male specimen described by Osten Sacken (l. c.), making this lectotype for the species. This species, together with *brevioricornis* is readily told from all other members of the genus by the snowy-white tarsi.

H. (*Eriocera*) **aurata** (Doane)
1900. *Eriocera aurata* Doane; Journ. N. Y. Ent. Soc., 8:194.

Fig.—Doane, *Ibid.*, pl. 8, fig. 13 (wing); 1900.

General coloration reddish yellow, the thorax unmarked, or in rarer cases with a small darkened spot on margin of scutum above wing-root. Antennae pale, if bent backward extending about to wing-root. Head brown. Knobs of halteres dark brown. Legs yellowish to brownish yellow, in the latter case, femora with a vague, more yellowish subterminal ring. Wings with R_{2+3} about one-half R_3 alone; inner end cell *1st* M_2 slightly arcuated. Abdomen brownish yellow; ovipositor with elongate chitinized valves. ♂. L. 9-13 mm.; w. 10-12 mm. ♀. L. 14-16 mm.; w. 11-13 mm.

(June-Aug.) N. C., S. C., Ga., Tenn., nw. Fla.

H. (*Eriocera*) **brachycera** (O. S.)
1877. *Eriocera brachycera* Osten Sacken: Bull. U. S. Geol. Surv., 3: 205.

Fig.—Alexander, Cfls. N. Y., 1, pl. 37, fig. 106 (wing); 1919.

Mesonotum praescutum obscure brownish yellow, with four clearly defined dark brown stripes, the lateral margin yellowish gray; ventral pleura clear gray. Antennae with basal segments obscure yellow, flagellum black. Knobs of halteres darkened. Femora yellow to brownish yellow, the tips narrowly blackened. Wings with a strong brown tinge, produced especially by broad seams to veins; R_{2+3} subequal to or a little shorter than R_3. Abdominal tergites dark brown, very narrowly yellowish laterally; sternites yellow; hypopygium dark; ovipositor with long chitinized valves. ♂. L. 13-17 mm.; w. 15-18 mm.; antenna, 4-5 mm. ♀. L. 25-27 mm.; w. 19-20 mm.

(Late June-early Aug.) Ont., Que., Me., N. H., Mass., N. Y., southw. to Tenn. and N. C.

H. (*Eriocera*) **brevioricornis** Alex. (Fig. 44, L).
1941. *Hexatoma* (*Eriocera*) *brevioricornis* Alexander: Amer. Midl. Nat., 26: 311.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 12, fig. 1 (wing); 1908 (as *albitarsis*). Alexander, Cfls. N. Y., 1, pl. 37, fig. 104 (wing); 1919 (as *albitarsis*).

Very similar to *albitarsis*, differing especially in the short antennae of the male sex, which are less than one-half the body. Wings more nearly hyaline. ♂. L. 6.5-7.5 mm.; w. 8-8.5 mm.; antennae, about 3.5 mm. ♀. L. 9-10 mm.; w. 9-10.5 mm.

(June-July) Que., southw. to Mass., Ct., N. Y., N. C., and Tenn., the latter in the mountains.

Connecticut.—Type-material of *albitarsis*; New London, on sea-beach. (Osten Sacken, Mon. Dipt. N. Amer., 4: 257-258; 1869).

H. (*Eriocera*) **cinerea** (Alex.)
1912. *Eriocera cinerea* Alexander; Psyche, 19: 169-170.

Figs.—Alexander, *Ibid.*, pl. 13, fig. 9 (wing); 1912. Alexander, Cfls. N. Y., 1, pl. 37, fig. 108 (wing); 1919.

Mesonotum yellowish gray, the praescutum with three conspicuous brown stripes, the median one broad and undivided; posterior sclerites and pleura clear gray. Antennae (♂) nearly three times body, basal flagellar segments microscopically spinose; antennae ♀ short. Vertical tubercle conspicuous, especially of ♂. Knobs of halteres weakly darkened. Femora yellow, tips narrowly blackened. Wings with a brownish tinge, produced by darkened seams to veins: R_{2+3} one-half or more of R_3; cell *1st* M_2 rectangular, with *m-cu* at near one-third to one-fourth its length. Abdomen dark brown, sparsely pruinose, extreme lateral margins of tergites pale. ♂. L. 9-10 mm.; w. 12-13 mm.; antenna, about 27 mm. ♀. L. 11-11.5 mm.; w. 11-11.5 mm.

(Late May-early July) Ont., Que., Me., N. H., Mass., N. Y., southw. to Va., S. C. and Tenn.

Connecticut.—Canaan, June 10, 1928 (R. B. F.); Storrs, 1929.

H. (*Eriocera*) **fuliginosa** (O. S.)
1859. *Eriocera fuliginosa* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 243.

Fig.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 28 (hyp.); 1869.

Praescutum with four slightly darker brown stripes. Antennae short in both sexes; basal segments pale. Femora rusty-yellow, tipped with dark brown. Wings brown, more suffused along veins, stigma darker. Abdomen brown. ♂. L. 10-12 mm.; w. 10-12 mm.

(July) N. H., westw. to Ind. and Mich., southw. to n. Fla.

I am still uncertain of the identity and limits of this fly and am inclined to consider it as being identical with *gibbosa*. The specimens mentioned by Osten Sacken from Va. and Ohio seem certainly to pertain to *gibbosa*. The species, *fuliginosa*, *gibbosa* and *tristis* are very closely related.

H. (*Eriocera*) **fultonensis** (Alex.)
1912. *Eriocera fultonensis* Alexander; Psyche, 19: 168-169.

Figs.—Alexander, *Ibid.*, 19, pl. 13, fig. 7 (wing); 1912. Alexander, Cfls. N. Y., 1, pl. 37, fig. 111 (wing); 1919.

Mesonotum yellowish gray, the praescutum with four narrow brownish black stripes; pleura more grayish pruinose. Antennae short in both sexes. Vertical tubercle weakly bifid. Knobs of halteres dark brown. Fore and middle femora brownish black, with about the basal half yellow, posterior femora brownish yellow, the tips narrowly blackened. Wings faintly tinged with brown, the veins broadly and conspicuously seamed with darker brown. Abdomen black, including the large hypopygium; ovipositor with long chitinized valves. ♂. L. 9.5-10 mm.; w. 9-10.5 mm. ♀. L. 11-11.5 mm.; w. 10.5-11.5 mm.

(June-Aug.) Mass., N. Y., southw. to Tenn.

H. (*Eriocera*) **gaspensis** (Alex.)
1931. *Eriocera gaspensis* Alexander; Can. Ent., 63: 143-144.

General coloration gray, the praescutum with three dark brown stripes; pleura black, heavily pruinose. Antenna seven- (♂) or eight- (♀) segmented. Femora obscure yellow, with more than distal half blackened. Wings pale brownish, the veins narrowly seamed with darker; *Rs* long, weakly angulated and spurred at origin; R_2 not far beyond fork of R_{2+3+4}. Abdomen pruinose. ♂. L. about 5-6 mm.; w. 6-7.2 mm. ♀. L. about 7 mm.; w. 8 mm.

(June) E. Que.

H. (*Eriocera*) **gibbosa** (Doane)
1900. *Eriocera gibbosa* Doane; Journ. N. Y. Ent. Soc., 8:193.

Fig.—Doane, *Ibid.*, 8, pl. 8, fig. 10 (wing); 1900.

General coloration brown, the mesonotum and pleura distinctly gray pruinose, the praescutum with four slightly darker brown stripes. Antennae with basal segments paler than the black flagellum. Vertical tubercle opaque. Femora obscure yellow, the tips narrowly blackened on all legs. Wings with a brown tinge, the veins a little seamed with brown; stigma darker. Abdomen dark brown, sparsely pruinose. ♂. L. about 10 mm.; w. about 11 mm. ♀. L. about 12 mm.; w. about 11 mm.

(Late May, June) Mass., Ct., westw. to Mich. and Ill., southw. to Va. and Tenn.

Connecticut.—Avon Old Farms, June 15, 1929 (C. H. C.); Salem, June 12, 1929 (W. E. B.).

I must regard this fly as being doubtfully distinct from *fuliginosa*.

H. (*Eriocera*) **longicornis** (Walk.) (Fig. 44, M).
1848. *Anisomera longicornis* Walker; List Dipt. Brit. Mus., 1:82.

Figs.—Alexander, Psyche, 19, pl. 13, fig. 10 (wing); 1912. Alexander, Cfls. N. Y., 1, pl. 37, fig. 107 (wing); 1919.

General coloration of thorax gray, the praescutum with three conspicuous dark brown stripes, the median one sometimes vaguely split. Antennae (♂) more than three times the entire body, the proximal flagellar segments with microscopic spinulae; of ♀ short, 11-segmented. Vertical tubercle very large, especially in ♂. Fore femora short. Wings with R_{2+3} and R_2 subequal. Abdomen brown, pruinose. Body (♂) with long pale setae. ♂. L. 10-11 mm.; w. 12-13 mm.; antenna, 35-40 mm. ♀. L. about 10 mm.; w. about 12 mm.

(May-early July) Ont., Que., Me., N. H., Mass., N. Y., westw. to Man., Ill. and Ia., southw. to Va. and N. C.

Connecticut.—Oxford, May 21, 1904 (W. E. B.).

H. (*Eriocera*) **spinosa** (O. S.) (Fig. 44, N).
1859. *Arrhenica spinosa* O. S.: Proc. Acad. Nat. Sci. Philadelphia. 1859:244.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 29 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 26, fig. 3 (wing); 1908 (as *longicornis*). Alexander, Cfls. N. Y., 1:850, fig. 125, F (ant. ♂), pl. 37, fig. 105 (wing); 1919.

Mesonotum and pleura light gray, the disk of praescutum more yellowish gray, with four distinct brown stripes. Antennae of male with flagellar segments having small cog-like spinulae almost to tip; antennae (♀) short. Vertical tubercle very large, especially in ♂. Knobs of halteres dark brown. Femora yellow, the tips narrowly infuscated to blackened. Wings with a grayish brown tinge, produced especially by broad dark seams to veins; R_{2+3} nearly as long as R_3. Abdominal tergites brownish black, narrowly yellowish laterally; hypopygium rusty brown; ovipositor with long sclerotized valves. Body (♂) clothed with long, erect pale setae. ♂. L. 15-18 mm.; w. 17-20 mm.; antenna, 35-50 mm. ♀. L. 25-28 mm.; w. 18-20 mm.

(May-Aug.) Que., Me., N. H., Vt., Mass., N. Y., westw. to Ill., southw. to Pa.

Connecticut.—Riverton, June 8, 1929 (C. P. A.).

H. (*Eriocera*) **tristis** (Alex.)
1914. *Eriocera tristis* Alexander: Proc. Acad. Nat. Sci. Philadelphia. 1914: 602.

Figs.—Alexander, Psyche, 19, pl. 13, fig. 8 (wing); 1912 (as *fuliginosa*). Alexander, Cfls. N. Y., 1, pl. 37, fig. 110 (wing); 1919.

Mesonotum dark brown, the praescutum with four slightly darker stripes, in cases with an additional capillary line on anterior half; pleura dark brown. Antennae brown, the basal two segments more reddish brown. Vertical tubercle entire. Knobs of halteres brownish black. Femora yellow, the tips narrowly but conspicuously blackened. Wings with stigma darker than the ground-color. Abdominal tergites black, sternites weakly bicolorous, obscure yellow, their apices broadly dark brown; ovipositor with sclerotized valves. ♂. L. 8-9 mm.; w. 8.5-9 mm. ♀. L. 11-12 mm.; w. 10-11 mm.

(July, Aug.) Mass., N. Y., westw. to Ind., southw. to Md. and Va.

H. (*Eriocera*) **wilsonii** (O. S.)
1869. *Eriocera wilsonii* Osten Sacken; Mon. Dipt. N. Amer., 4: 255.
1900. *E. antennaria* Doane; Journ. N. Y. Ent. Soc., 8: 194.

Figs.—Doane, *Ibid.*, pl. 8, fig. 12 (wing); 1900. Alexander, Cfls. N. Y., 1, pl. 37, fig. 109 (wing); 1919.

General coloration polished rusty-red, the praescutal stripes lacking or very faintly indicated. Antennae (♂) with basal segments yellow, the outer ones black; flagellar segments provided only with erect pale setae, no spinulae. Knobs of halteres weakly darkened. Legs yellow, the tips of femora, tibiae and basitarsi blackened. Wings with R_{2+3} subequal to or longer than R_{2+3+4}; *m-cu* some distance beyond fork of *M*. Abdomen reddish yellow. ♂. L. 7.5-8 mm.; w. 9-10 mm.; antennae, 14-16 mm.

(May-July) Del., westw. to O., southw. to Va. and N. C.

7. Subtribe Atarbaria

Atarba Osten Sacken

1869. *Atarba* Osten Sacken; Mon. Dipt. N. Amer., 4: 127-128.

In our region, *Atarba* includes only the genotype, *picticornis*. The genus is very isolated in its affinities and it is by no means certain that its present position in the Hexatomini is the correct one (*vide*, Alexander, Diptera of Patagonia and S. Chile, 1: 167; 1929; under *Ischnothrix*). The chief structural peculiarity lies in the very large meron which separates widely the middle and hind coxae. The tibial spurs in the local species are small but perfectly distinct. The venation shows few distinctive features other than the loss of R_2 and the presence of but two branches of *Rs*, both characters being shared with *Elephantomyia* (Fig. 44, O, P). The antennae of *picticornis* are elongate and bicolorous in the male sex. The adult flies are not uncommon in shaded open woods. The early stages occur in saturated decaying wood (Rogers, Florida Ent., 10: 49-55, figs. 1-7; 1927).

Atarba (*Atarba*) **picticornis** O. S. (Fig. 44, O).
1869. *Atarba picticornis* Osten Sacken: Mon. Dipt. N. Amer., 4: 128-129.

Figs.—Osten Sacken, *Ibid.*, pl. 1, fig. 13 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 29, fig. 3 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 33, fig. 47 (ven.); 1919.

General coloration polished yellow, the thoracic pleura weakly pruinose. Antennae (♂) elongate, if bent backward extending about to third abdominal segment, bicolorous, the basal half of individual segments yellow, the outer half black, the dark color increasing in amount on outer segments; antennae (♀) shorter. Head slightly grayish brown. Legs yellow. Wings (Fig. 44, O) with a strong yellow to brownish yellow tinge, the stigma barely indicated: Sc_1 ending opposite origin of *Rs*; *m-cu* close to fork of *M*. Abdomen chiefly obscure yellow, with a blackened subterminal ring (in ♂). ♂. L. 5.5-6 mm.; w. 6-7 mm. ♀. L. 6.8-7 mm.; w. 7-7.5 mm.

(Late June, July) N. H., Mass., Ct., N. Y., westw. to Mich., Ill., Ind., Tenn. and Mo., southw. to S. C., Ga., n. Fla. and La. (Transition, Austral).

Connecticut.—Brooklyn, June 15, 1933 (C. P. A.); East River, July 13, 1910 (Ely).

8. Subtribe Elephantomyaria

Elephantomyia Osten Sacken

1859. *Elephantomyia* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 220.

A very distinct genus which is well-characterized by the exceedingly elongate rostrum that is nearly as long as the entire body (Fig. 46, L). Other features of note lie in the antennae, which show the beginnings of a fusion-segment involving the basal flagellar segments, and with long conspicuous verticils on all segments. The venation (Fig. 44, P) shows R_2 entirely lacking; two branches of *Rs*; *m-cu* at near midlength of the large cell *1st* M_2 and subequal to the distal section of Cu_1. The tibial spurs are short but perfectly distinct. The male hypopygium has the aedeagus developed into an elongate coiled penefilum. The adult flies are not uncommon in open mesophytic woods. The early stages occur in decaying wood. In our fauna there is a single species, with a local race described at this time.

Elephantomyia (*Elephantomyia*) **westwoodi** O. S. (Figs. 44, P; 46, L).
1869. *Elephantomyia westwoodi* Osten Sacken: Mon. Dipt. N. Amer., 4: 109.

Figs.—Osten Sacken, *Ibid.*, 4, pl. 1, fig. 5 (wing); pl. 3, fig. 8 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 29, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1; 846, fig. 124 (head); pl. 33, fig. 44 (wing); 1919.

General coloration of thorax obscure yellow, the posterior sclerites of mesonotum more infumed. Head yellowish gray; eyes very large, restricting the vertex. Legs yellow, the femoral tips narrowly black-

ened. Wings (Fig. 44, P) with a strong yellow tinge, the oval stigma dark brown, conspicuous; vague seams along cord and outer end of cell *1st* M_2; wing-tip narrowly darkened; *Rs* angulated and usually short-spurred at origin. Abdomen obscure yellow, the tergites with ⊥-shaped darker markings; a subterminal blackened ring. ♂. L., excluding rostrum, 7.5-8 mm.; w. 8-8.5 mm.; rostrum, 7.5 mm. ♀. L., excluding rostrum, 10-11 mm.; w. 10 mm.; rostrum, 8-8.5 mm.

One small female measures only 8 mm. in body and wing length and, except in the abdominal pattern, approaches the race described below.

(June-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Wisc., Mich. and Ill., southw. to S. C., Ga. and Fla.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); East River, June 5, 1910 (Ely); Rowayton, June 16, 1909 (C. W. J.).

A very small race of this species has been taken in various parts of the Adirondack Mountains, N. Y.

Elephantomyia westwoodi adirondacensis subsp. nov.

Similar to the typical form but much smaller. Abdominal segments with conspicuous black lateral areas but with the dorso-median portion clear yellow. The male sex is unknown. ♀. L., excluding rostrum, 7.5-8 mm.; w. 7.5-8 mm.; rostrum, 4.8-5 mm.

Holotype, ♀, Wilmington Notch, Essex Co., N. Y., June 13, 1927 (C. P. Alexander); in author's collection. Paratopotypes, 2 ♀ ♀.

I have also taken this form at Lake Pleasant, Hamilton Co., N. Y., June 22, 1926.

Eriopterini

One of the largest and best-known tribes of crane-flies. In our fauna, representatives of four subtribes occur. The tribe is very close to the Hexatomini, especially in the two subtribes Claduraria and Gonomyaria, where the chief character available for referring the groups to the present tribe is to be found in the absence of tibial spurs.

Key to Subtribes and Genera

1. Nearly apterous species, the wings reduced to microscopic structures that are smaller than the halteres. (Claduraria) .... **Chionea**
   Fully-winged species 2
2. Wings with cell M_1 present. (Claduraria) 3
   Wings with cell M_1 lacking 4
3. Vein R_{2+3+4} shorter than vein R_3, cell R_3 being much longer than its petiole; R_2 far beyond fork of R_{2+3+4} (Fig. 47, A) .... **Cladura**
   Vein R_{2+3+4} longer than vein R_3, cell R_3 being subequal to its petiole; vein R_2 at or before fork of R_{3+4} (Fig. 47, B) .... **Neolimnophila**
4. Rostrum very long and slender, about as long as the combined head and thorax; setae of legs profoundly bifid (Fig. 50, M) (Toxorhinaria) **Toxorhina**
   Rostrum short, not exceeding the remainder of head 5
5. Two branches of *Rs* reach the wing-margin (Fig. 47, E-G) (Gonomyaria) 6
   Three branches of *Rs* reach the wing-margin (Fig. 47, H-N; Fig. 50, A-L) 7

6. Wings with Sc long, Sc_1 ending beyond origin of Rs; *m-cu* beyond fork of M (Fig. 47, E) .... **Teucholabis**
Wings with Sc short, Sc_1 ending before origin of Rs; *m-cu* at or before fork of M (Fig. 47, F, G) .... **Gonomyia** (part)
7. Wings with vein R_3 shorter than the petiole of cell R_3, cell R_3 short (Fig. 47, H-M; Fig. 50, B, C) 8
Wings with vein R_3 longer than the petiole of cell R_3, cell R_3 long (Fig. 47, N; Fig. 50, A, D-L) 11
8. Vein R_2 present (Fig. 47, M; Fig. 50, B, C). (Eriopteraria) 9
Vein R_2 lacking (Fig. 47, H-L) 10
9. Rs elongate, exceeding distal section of M_{1+2} (Fig. 47, M); tuberculate pits on cephalic portion of praescutum; trochanters elongate .... **Rhabdomastix** (part)
Rs shorter, less than the distal section of M_{1+2} (Fig. 50, B, C); tuberculate pits removed from cephalic margin of praescutum, nearly in transverse alignment with the pseudosutural foveae; trochanters short **Erioptera** (part)
10. Sc long, Sc_1 extending from opposite midlength to just before the fork of Rs; *m-cu* at or beyond the fork of M (Fig. 47, L) (Eriopteraria) **Rhabdomastix** (part)
Sc short, not extending beyond midlength of Rs (Fig. 47, H, J, K); if Sc is relatively long, *m-cu* lies more than its own length before fork of M (Fig. 47, I) (Gonomyaria) .... **Gonomyia** (part)
11. Wings with distinct macrotrichia in outer cells (Fig. 50, I-K) 12
Wings with the outer cells glabrous (Fig. 50, A-H) 15
12. Rs shortened, its union with R_{2+3+4} forming an angle, so cell R_1 is nearly equilateral in outline (Fig. 50, I) (Eriopteraria) .... **Cryptolabis**
Rs long, normal in position; cell R_1 elongate (Fig. 50, J, K) 13
13. Size very small (wing, 2.6 mm. or less); Rs ending in cell R_3, this cell being sessile, without element R_{2+3+4} (Fig. 50, K) (Eriopteraria) .... **Tasiocera (Dasymolophilus)**
Size larger (wing 4 mm. or over); Rs ending in cell R_3, cell R_3 being petiolate by the presence of a distinct element R_{2+3+4} (Fig. 50, J) 14
14. Sc_2 close to tip of Sc_1, the two veins thus subequal in length (Gonomyaria) .... **Gnophomyia** (part)
Sc_2 far removed from tip of Sc_1, the latter vein long, subequal in length to Rs (Fig. 50, J) (Eriopteraria) .... **Ormosia** 462
15. Rs ending in cell R_3, there being no element R_{2+3+4} (Fig. 50, L) (Eriopteraria) .... **Molophilus** 476
Rs ending in cell R_4, cell R_3 being petiolate by a distinct element R_{2+3+4} (Fig. 47, C, D, N; Fig. 50, A, D-H) 16
16. A supernumerary crossvein in cell R_3; vein *2nd A* strongly sinuate (Fig. 47, N) (Eriopteraria) .... **Symplecta**
No supernumerary crossvein in cell R_3; vein *2nd A* straight or only weakly sinuate (Fig. 50, D-H) 17
17. Coxae of middle and hind legs only slightly separated by the small meral region; Sc_1 relatively short, not exceeding one-fourth the length of Rs (Fig. 47, C, D) (Gonomyaria) 18
Coxae of middle and hind legs widely separated by a large "pot-bellied" meral region; Sc_1 very long, exceeding one-half of Rs (Fig. 50, A, D-H) (Eriopteraria) 19
18. Wings with *m-cu* some distance beyond the fork of M; R_{1+2} long, more than three times R_2 and exceeding R_{2+3+4} (Fig. 47, C) .. **Gnophomyia** (part)
Wings with *m-cu* at or close to fork of M; R_{1+2} short, subequal to R_2 and less than one-half R_{2+3+4} (Fig. 47, D) .... **Lipsothrix**
19. Vein Cu_1 nearly straight, the distal section not swinging cephalad toward wing-tip; cell *1st* M_2 present, small, less than one-half the distal section of M_{1+2} (Fig. 50, A, E) 20
Vein Cu_1 with distal section slightly deflected at apex toward wing-tip; cell *1st* M_2, when present, elongate, subequal to or longer than the distal section of M_{1+2} (Fig. 50, G, H) .... **Erioptera** (part)

20. Terminal three segments of antennae suddenly smaller than those preceding; body-coloration dull gray or buffy (Fig. 50, A) .... **Trimicra**
   Antennal segments gradually decreasing in size toward end; coloration of local species coal-black, variegated with yellow (Fig. 50, F) .... **Erioptera** (part)

1. Subtribe Cladurария

Cladura Osten Sacken

1859. *Cladura* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 229.

A small genus of flies, most numerous in species in Japan. The adults are on the wing in late summer and autumn. The early stages occur in relatively dry soil in mesophytic woodlands.

Key to Species

1. Larger (w., 7 mm. or more); reddish yellow, the thoracic pleura sparsely variegated with brown spots; wings yellowish, the crossveins and deflections of veins clouded with brown; *Sc* long, Sc_1 ending beyond fork of R_{2+3+4}, Sc_2 opposite this fork; R_2 much shorter than R_{2+3}, usually one-fourth to one-fifth this length; petiole of cell M_1 short, not greatly exceeding *m* (Fig. 47, A); male hypopygium with a single dististyle. (Subgenus *Cladura*) .... **flavoferruginea**
   Smaller (w., 6 mm. or less); very pale yellow or whitish yellow, without spots on pleura; wings hyaline, without conspicuous darkened areas on the crossveins; *Sc* relatively short, Sc_1 ending opposite two-thirds the length of R_{2+3+4}, Sc_2 nearly opposite or shortly beyond the fork of *Rs*; R_2 only a little shorter than R_{2+3}; petiole of cell M_1 long, about two or three times *m*; male hypopygium with two dististyles. (Subgenus *Neocladura* Alexander) .... **delicatula**

Cladura (*Neocladura*) **delicatula** Alex.
1914. *Cladura delicatula* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1914: 589-590.

Fig.—Alexander, *Ibid.*, pl. fig. *27* (wing); 1914.

General coloration pale yellow, the mesonotal praescutum darker medially. Abdomen narrowly margined laterally with dark brown. ♂. L. 4.5-5 mm.; w. 5.6-6 mm. ♀. L. 4.5-4.8 mm.; w. 5.5-5.7 mm.

(Sept.) Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to S. C. and Tenn.

C. (*Cladura*) **flavoferruginea** O. S. (Fig. 47, A).
1859. *Cladura flavoferruginea* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 229.
1861. *C. indivisa* Osten Sacken; *Ibid.*, 1861: 291.

Figs.—Osten Sacken, Proc. Acad. Nat. Sci. Philadelphia, pl. 4, fig. 34: 1859. Osten Sacken, Mon. Dipt. N. Amer., 4: 34 (ven.), pl. 4, fig. *22* (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. *22*, fig. 2 (ven.); 1908. Alexander and Leonard, Journ. N. Y. Ent. Soc., *20*: 36-39, pl. 4 (abnormal ven.); 1912. Alexander, Cfls. N. Y., 1, pl. 37, fig. 102 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, figs. 19, 22 (thorax); 1925. Dickinson, Cfls. Wisc., p. 198, fig. 87 (wing); 1932.

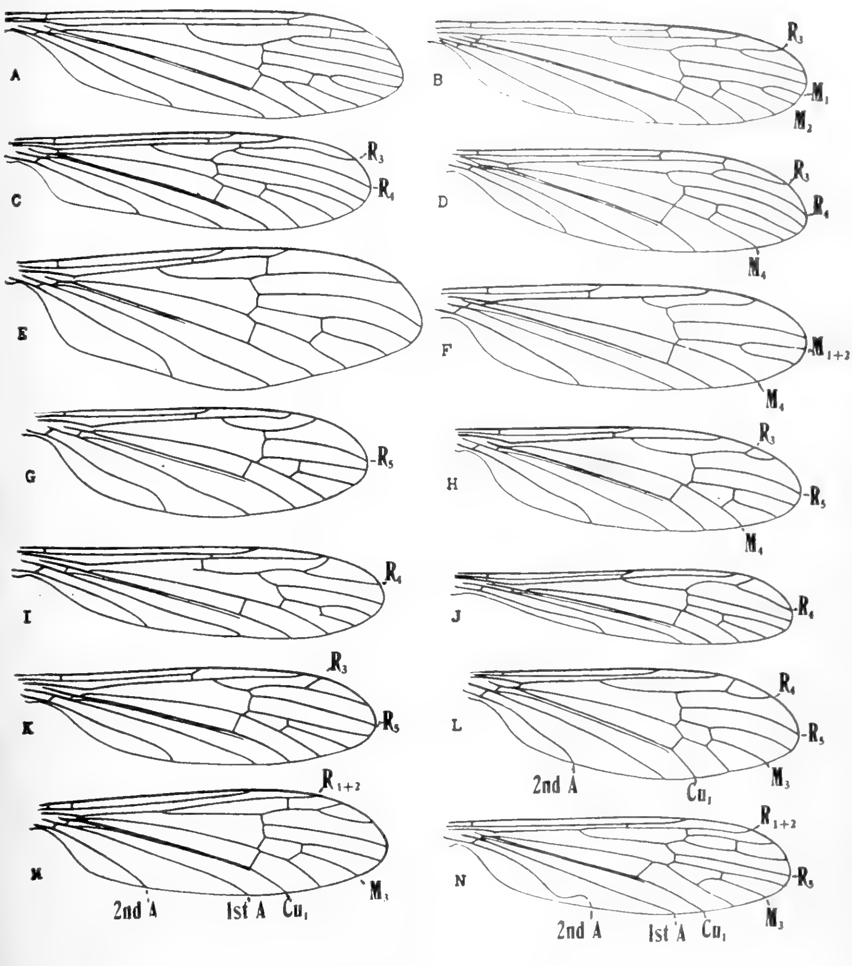


FIGURE 47. Eriopterini; venation.

A. *Cladura (Cladura) flavoferruginea* O. S.
B. *Neolimnophila ultima* (O. S.)
C. *Gnophomyia tristissima* O. S.
D. *Lipsothrix sylvia* (Alex.)
E. *Teucholabis (Teucholabis) complexa* O. S.
F. *Gonomyia (Lipophleps) alexanderi* (Johns.)
G. *G. (L.) puer* Alex.
H. *G. (L.) sulphurella* O. S.
I. *G. (Idiocera) blanda* O. S.
J. *G. (Gonomyia) bidentata* Alex.
K. *G. (G.) noveboracensis* Alex.
L. *Rhabdomastix (Sacandaga) brittoni* Alex.
M. *R. (S.) subarctica* Alex.
N. *Symplecta cana* (Walker)

Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius.

Pseudosutural foveae blackened. Wings (Fig. 47, A). Abdominal segments conspicuously cross-banded with brown, the incisures yellow; subterminal segments black; male hypopygium large, yellow.

Adventitious crossveins in the wing appear rather commonly in this species, the one most frequent being that in cell R_3 (Alexander & Leonard, l. c.) ♂. L. 6-7 mm.; w. 7-8.5 mm. ♀. L. 7-8 mm.; w. 8-9.5 mm.

(Sept., Oct.) Que., Me., N. H., Vt., Mass., N. Y., westw. to Wisc., Ia. and Mo., southw. to N. C. and S. C.

Chionea Dalman

1816. *Chionea* Dalman; K. Vetensk. Akad. Handl. 1:102.
1912. *Sphaeconophilus* Becker; Ann. Soc. Ent. Belgique, 56:142.

Species of *Chionea* are the only nearly apterous crane-flies in the local fauna. Members of the genus are widely distributed throughout the Holarctic Region. The adults are most in evidence during warm days in winter, when they are to be found walking slowly and awkwardly about over the snow, in company with spiders, which they much resemble. The early stages live in soil beneath leaf mold.

Besides the almost complete loss of wings, the most striking characters lie in the antennae. The elongate pedicel is almost unique in the family. A certain number of flagellar segments are involved in the composition of the conical basal or fusion-segment; the primitive number of antennal segments for the tribe is 16; the most generalized local species of *Chionea* (*primitiva*) shows nine segments beyond the fusion-segment, which is thus apparently comprised of five consolidated segments; the commonest local species (*valga*) has only four segments beyond the fusion-segment, which is thus evidently composed of ten such segments. The greatest reduction so far made known is in *Chionea alexandriana* Garrett, of northwestern North America, where there are only three free segments beyond the fusion. I have discussed elsewhere the relationships of *Chionea* and the manner in which the antennae have been reduced (Can. Ent., 49:202-204; 1917).

Key to Species

1. Coloration of body dark brownish gray .... **noveboracensis**
   Coloration of body reddish yellow, rusty brown to dark brown 2
2. Body long and slender; male with all legs very long and slender, not incrassated .... **gracilis**
   Body stouter; males with at least the posterior femora incrassated 3
3. Antennae with 12 segments, there being 9 flagellar segments beyond the first or fusion-segment .... **primitiva**
   Antennae with 7 segments, there being 4 beyond the fusion-segment 4
4. Size very large (♂, L. 6-6.5 mm.) .... **waughi**
   Size smaller (♂, L. about 4-5 mm.) .... **valga**

Chionea gracilis Alex.

1917. *Chionea gracilis* Alexander; Can. Ent., 49:203.

Fig.—Alexander, *Ibid.*, 49, pl. 12, fig. 2 (ad. ♂); 1917.

General coloration brownish yellow. ♂. L. 3.9 mm.; diameter across pronotum, 0.6 mm.

(Dec.) N. Y.

C. noveboracensis Alex.
1917. *Chionea noveboracensis* Alexander; Can. Ent., 49:205.

Antennae black. Ovipositor long and conspicuous. ♀. L. about 3.5 mm.

(Feb.) N. Y.

C. primitiva Alex.
1917. *Chionea primitiva* Alexander; Can. Ent., 49:204.

Figs.—Alexander, *Ibid.*, 49:203, fig. 1 (ad. ♂), fig. 4 (ant.); 1917.

Readily told from the other species in our fauna by the number of antennal segments. ♂. L. 5.5-5.8 mm.; diameter across pronotum, 1.3-1.5 mm.

(Nov.) Mass., N. Y.

C. valga Harr.
1841. *Chionea valga* Harris; Insects Injur. to Vegetation, Ed. 3:601.
1848. *C. aspera* Walker; List Dipt. Brit. Mus., 1:82.
1848. *C. scita* Walker; *Ibid.*, 1:82.

Figs.—Harris, *Ibid.*, fig. 260; 1841. Johnson, Psyche, 14:43 (ad. ♂, ♀); 1907. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 9; pl. 3, fig. 20 (thorax); 1925.

General coloration reddish brown. All femora more or less incrassated in males, especially the somewhat bowed posterior femora. ♂. L. 4-5.5 mm.; diameter across pronotum, 0.8-1.2 mm. ♀. L. about 5 mm.; diameter across pronotum, about 0.9 mm.

(Dec.-Feb.) Ont., Que., Me., N. H., Mass., N. Y., westw. to Minn. and Sask.

C. waughi Curr.
1925. *Chionea waughi* Curran; Can. Ent., 57:24.

Most readily told from *valga*, its nearest ally, by the average larger size. The posterior femora are more strongly incrassated than are the others. ♂. L. 6-6.5 mm.; diameter across pronotum, about 1.2 mm. ♀. L. 5.5 mm.; diameter across pronotum, about 0.8 mm.

(Sept.-Dec.) Lab.

Neolimnophila Alexander

1920. *Limnophila (Neolimnophila)* Alexander; Proc. California Acad. Sci., (4) 10:37-38.

A small genus of Holarctic crane-flies, most numerous in species in Eastern Asia. The adults are on the wing in Spring and again in Autumn, occurring in small dancing swarms. The early stages presumably live in garden soil and similar situations.

Neolimnophila ultima (O. S.) (Fig. 47, B).
1859. *Limnophila ultima* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 238.

Figs.—Osten Sacken, *Ibid.*, pl. 4, fig. 26; 1859. Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 24 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 38, fig. 127 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, figs. 18, 23 (thorax); 1925. Dickinson, Cfls. Wisc., p. 198, fig. 86 (wing); 1932.

General coloration gray, the praescutum with four dark brown stripes. Halteres chiefly pale. Wings subhyaline, stigma faintly indicated (Fig. 47, B). The members of this genus, in common with all other Cladurarìa, have the basal flagellar segments united into a fusion-segment. ♂. L. about 5-6 mm.; w. 7-7.5 mm. ♀. L. 7-8 mm.; w. 8-9 mm.

(May; Sept., Oct.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. and northwestw. to Mich., Iowa, Alta. and Alaska, southw. to Ga. and Miss. (Eastern Palaearctic).

Connecticut.—W. Granby, Sept. 11, 1928 (C. P. A.).

2. Subtribe Gonomyaria

Gnophomyia Osten Sacken

1859. *Gnophomyia* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 223.

An extensive genus of medium-sized flies, with two species within our faunal limits. The adult flies may be swept from rank vegetation in mesophytic woodlands. The immature stages occur beneath the bark of decaying deciduous trees.

Key to Species

1. Apical cells of wings with macrotrichia; halteres black throughout ....**luctuosa**
   Cells of wings without macrotrichia; knobs of halteres light yellow **tristissima**

Gnophomyia luctuosa O. S.
1859. *Gnophomyia luctuosa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 224.
1860. *Limnobia nigricola* Walker: Trans. Ent. Soc. London (n. s.), 5: 333.

Body, with antennae, legs, halteres and wings black. Wings with basal section of R_5 perpendicular to end of *Rs*, subequal in length to *r-m*. ♂. L. 6-7 mm.; w. 7-8 mm. ♀. L. 7.5-8 mm.; w. 7-7.5 mm.

(May-Aug.) S. Ind., Ill., D. C., southw. and southwestw. to Fla. and Miss. (Austral).

G. tristissima O. S. (Fig. 47, C).
1859. *Gnophomyia tristissima* Osten Sacken; *Ibid.*, 1859: 224.

Figs.—Osten Sacken, *Ibid.*, pl. 4, fig. 18; 1859. Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 5 (wing), pl. 4, fig. 19 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 24, fig. 2 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 37, fig. 100 (wing); 1919. Crampton, Ann. Ent. Soc. America, 18, pl. 3, fig. 8 (thorax); 1925. Dickinson, Cfls. Wisc., p. 190, fig. 71 (wing); 1932.

Black, with strongly darkened wings. Wings with basal section of R_5 short to very short, in approximate alignment with *Rs*. ♂. L. 6-8 mm.; w. 5.5-8 mm. ♀. 7.5-8 mm.; w. 6-7 mm.

(June-Aug.) Que., Ont., Me., N. H., Vt., Mass., R. I. and N. Y., westw. to Ia., Kan. and Tex., southw. to S. C., Ga., Fla. and Ala.

Connecticut.—New Haven, July 20, 1929 (W. E. B.); Riverton, June 8, 1929 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

Lipsothrix Loew

1873. *Lipsothrix* Loew: Beschreib. Eur. Dipt., 3: 69.

A small genus, including twelve described recent species, widespread throughout the Holarctic Region. A single species in eastern North America. The adults frequent the vicinity of streams, often near small waterfalls. The immature stages are unknown.

Lipsothrix sylvia (Alex.) (Fig. 47, D; 51, A).
1916. *Limnophila sylvia* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 534-535.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 46 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 40, fig. 157 (wing); 1919.

Mesonotum above dark brown, the sides of thorax paling to obscure yellow. Wings (Fig. 47, D) with a faint brownish tinge, the stigma poorly indicated; R_{1+2} and R_2 subequal; basal section R_5 strongly arcuated or angulated; *m-cu* not far from fork of *M*. Male hypopygium (Fig. 51, A) with the interbasal structures appearing as conspicuous blackened rods that narrow abruptly into a terminal spine. ♂. L. 5-6 mm.; w. 5.5-7 mm. ♀. L. 6-7.5 mm.; w. 6.5-8 mm.

(June-Aug.) Me., N. H., Vt., Mass., N. Y., southw. to N. C., S. C. and Tenn.

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); Union, June 14, 1933 (C. P. A.).

Teucholabis Osten Sacken

1859. *Teucholabis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia. 1859: 222.

An extensive, essentially tropical genus, with few species in the local fauna. The immature stages occur in decaying wood.

The various species have the notum highly polished, the pleura often with a silvery pruinosity. The general appearance is thus quite different from the allied genus *Gonomyia*. The males of most species of *Teucholabis* have a curious pocket of setae on the seventh abdominal sternite.

Key to Species

1. *Sc* long, Sc_1 ending far beyond midlength of *Rs* (Fig. 47, E) 2
   Sc short, Sc_1 ending slightly beyond origin of *Rs* 3
2. Mesonotal praescutum with three black stripes; male hypopygium with the spine of the basistyle very small; outer dististyle simple; aedeagus with terminal spine very short .... complexa

Mesonotum reddish, unmarked with darker, in cases with black stripes; male hypopygium with the spine of basistyle large, apical in position; outer dististyle at midlength bearing a lateral branch; aedeagus terminating in a long straight apical spine .... **immaculata**

3. Wings with cell R_2 at margin more extensive than is cell R_4; thoracic pleura chiefly pale brown, with an indistinct darker brown longitudinal stripe .... **carolinensis**

Wings with cell R_4 at margin more extensive than cell R_2; thoracic pleura black, with a whitish longitudinal stripe passing beneath the halteres. **lucida**

Teucholabis (*Teucholabis*) **carolinensis** Alex.
1916. *Teucholabis carolinensis* Alexander; Can. Ent., 48: 44.

Lateral margins of praescutum and the thoracic pleura chiefly yellow, with a dorsal blackish pleural area that extends backward about to the level of the wing-root. Wings with branches of *Rs* extending generally parallel to one another. ♂. L. 4-4.2 mm.; w. 3.8-4 mm.

(Aug.) S. C. to Fla. (Austroriparian).

T. (*Teucholabis*) **complexa** O. S. (Fig. 47, E).
1859. *Teucholabis complexa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 223.

Figs.—Osten Sacken, *Ibid.*, pl. 3, fig. 10; 1859. Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 12 (wing), pl. 3, fig. 9 (hyp.); 1869. Williston, Man. N. Amer. Dipt., Ed. 3, fig. 25, sub 30 (wing); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 25, fig. 15 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 52 (wing); 1919. Crampton, Insect. Inscit. Menst., 13, pl. 3, fig. 14 (thorax); 1925.

General coloration obscure yellow, the praescutum with three black to brownish black stripes; scutal lobes chiefly blackened. Pleura chiefly black, with obscure yellow areas on ventral portion. ♂. L. 6-7 mm.; w. 6.5-8 mm.

(July, Aug.) Ct., N. J., westw. to Mich., Ill. and Okla., southw. to Ga., Fla. and Ala. (Austral).

Osten Sacken's type record from northern New York is almost certainly in error.

Connecticut.—East River, July 9, 1910 (Ely).

T. (*Teucholabis*) **immaculata** Alex.
1922. *Teucholabis complexa immaculata* Alexander; Occas. Papers Mus. Zool., Univ. Michigan, 127: 5-6.

Quite as in the typical form but with the mesonotum shiny reddish, unmarked.

For a discussion of *complexa* and *immaculata*, see Alexander, Amer. Mid. Nat., 24: 636-638; 1940.

(June) Ind., Tenn. (Carolinian).

T. (*Teucholabis*) **lucida** Alex.
1916. *Teucholabis* (*Teucholabis*) *lucida* Alexander; Can. Ent., 48: 43.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 25, fig. 16 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 33, fig. 53 (wing); 1919.

Praescutum polished black, humeral region light yellow; pleura with a whitish longitudinal stripe. Knobs of halteres weakly darkened. Wings relatively narrow. ♂. L. 3.5-4.2 mm.; w. 4.2-4.5 mm.

(July, Aug.) Va., westw. to Ind. and Mo., southw. to Ga. and n. Fla. (Austral).

Gonomyia Meigen

1818. *Gonomyia* Meigen; Syst. Beschr. Eur. Dipt., 1: 146.
1869. *Goniomyia* Osten Sacken; Mon. Dipt. N. Amer., 4: 176.

One of the largest genera of eriopterine Tipulidae. The flies frequent shaded places in woods (as *florens*), open ravines (as *bidentata*), and similar situations. Others are very characteristic of the sandy margins of streams, where they may be swept from herbage, as *alexanderi*, *sacandaga*, *mathesoni*, *sulphurella*, *kansensis*, *noveboracensis*, etc.). The early stages occur in wet soil.

The chief venational peculiarities lie in the small cell R_3, which is lost in most species of the subgenus *Lipophleps*. The adults are most often colored yellow and dark brown, in contrasted patterns.

Key to Subgenera

1. Two branches of *Rs* reach the wing-margin (Fig. 47, F, G) .. **Lipophleps** (part)
   Three branches of *Rs* reach the wing-margin (Fig. 47, H-K) 2

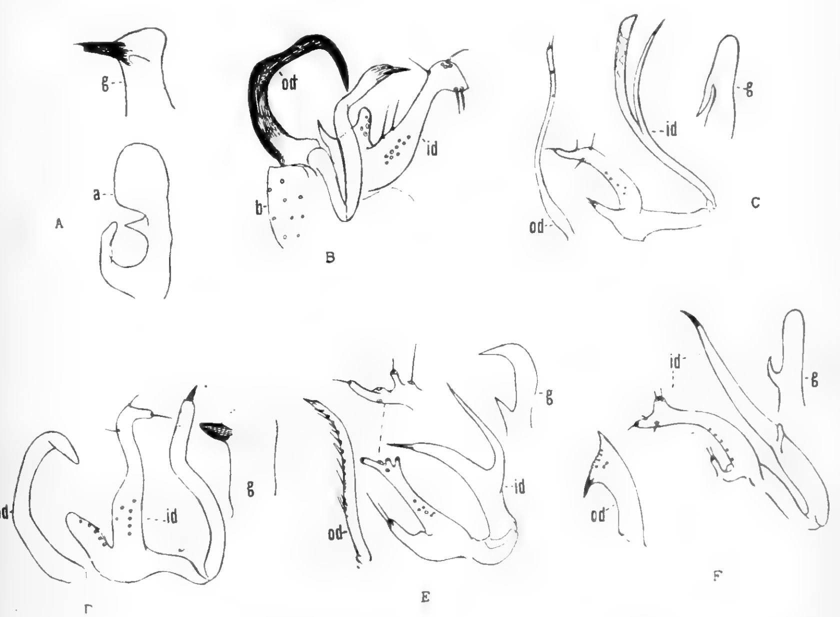


FIGURE 48. *Gonomyia, cognatella* group; male hypopygia.

A. *Gonomyia (Gonomyia) armigera* Alex.
B. *G. (G.) armigera* Alex.
C. *G. (G.) cognatella* O. S.
D. *G. (G.) florens* Alex.
E. *G. (G.) kansensis* Alex.
F. *G. (G.) reflexa* Alex.

Symbols: *a*, aedeagus; *b*, basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle.

2. Cell R_3 very small, its extent along costal margin subequal to that of cell R_2 (Fig. 47, H) .... **Lipophleps** (part)
   Cell R_3 large, its extent along costal margin much greater than that of cell R_2 (Fig. 47, I-K) 3
3. Wings with *m-cu* about its own length before fork of *M* (Fig. 47, I) .. **Idiocera**
   Wings with *m-cu* at or close to fork of *M* (Fig. 47, J, K) .... **Gonomyia**

Subgenus **Lipophleps** Bergroth

1889. *Leiponeura* Skuse; Proc. Linn. Soc. New South Wales, (2) 4:795 (preoccupied).
1915. *Lipophleps* Bergroth; Psyche, 22:55.

I am following Edwards in including in this subgenus not only all regional species of *Gonomyia* having two branches of *Rs*, but also those forms having three such branches, in which cell R_3 is very small and evidently tending to be lost by fusion of adjoining veins (Fig. 47, H). In our fauna, this latter group includes only *sulphurella*. The male antennae of members of this subgenus have exceedingly elongate verticils on the antennal flagellum.

Key to Species

(Based in part on male characters)

1. Wings with three branches of *Rs* reaching the margin, cell R_3 being present (Fig. 47, H) .... **sulphurella**
   Wings with two branches of *Rs* reaching the margin, cell R_3 being lost by fusion of enclosing veins (Fig. 47, F, G) 2
2. Legs with tibiae snowy-white; wings with cell *1st* M_2 open by atrophy of basal section of M_3 (Fig. 47, F); costal margin china-white........ **alexanderi**
   Legs without white on tibiae; wings with cell *1st* M_2 closed (Fig. 47, G); costal margin brown or yellow 3
3. Wings grayish brown, the costal border broadly light sulphur-yellow; stigma pale brown, preceded and followed by yellowish areas; abdominal segments brown, narrowly ringed caudally with yellow .... **sacandaga**
   Wings with the costal border concolorous with remainder of wing or nearly so, where more brightened, the stigma conspicuously dark brown; abdominal segments uniformly darkened, or else pale with narrowly darkened incisures 4
4. Stigma very conspicuous, dark brown; femora with a darkened nearly terminal ring (extra-limital) .... **pleuralis**
   Stigma lacking; femora uniformly brown 5
5. Thoracic pleura pale, only slightly if at all striped with darker; male hypopygium with the dististyle entirely fleshy, terminating in a single fasciculate seta (Fig. 49, A) .... **manca**
   Thoracic pleura with the ground-color dark, striped longitudinally with pale yellow; male hypopygium with the dististyle a blackened curved hook, these of different sizes on the two sides of body (Fig. 49, B) .... **puer**

Gonomyia (*Lipophleps*) **alexanderi** (Johns.) (Fig. 47, F).

1912. *Elliptera alexanderi* Johnson; Psyche, 19:3.
1916. *Gonomyia* (*Leiponeura*) *alexanderi* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916:513-514.

Figs.—Johnson, *Ibid.,* 19:3, fig. 6 (ven.); 1912. Alexander, *Ibid.,* pl. 26, fig. 17 (wing); pl. 29, figs. 59, 61 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 86 (wing); 1919.

Fore femora black; mid-femora yellow, the tips conspicuously blackened; hind femora yellow, with a narrow brown subterminal

ring: all tibiae white, the tips narrowly blackened. Thoracic pleura gray dorsally, dark brown ventrally, narrowly but conspicuously striped with pale yellow and black. ♂. L. about 3.5-3.8 mm.; w. 3.6-4.2 mm. ♀. L. about 5 mm.; w. about 5 mm.

(June-Aug.) Que., Vt. and N. Y., westw. to Ind., Ill., Mo. and Okla., southw. to N. C. and S. C.

G. (*Lipophleps*) **manca** (O. S.) (Fig. 49, A).
1869. *Goniomyia manca* Osten Sacken: Mon. Dipt. N. Amer., 4: 178-179.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 22 (wing); pl. 29, figs. 64, 65 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 88 (ven.); 1919.

General coloration of mesonotum light brown, scutellum broadly yellow. Male hypopygium (Fig. 49, A): gonapophyses appearing as simple blackened hooks. ♂. L. about 3.7-3.8 mm.; w. 3.5-3.6 mm. ♀. L. about 3.8-4 mm.; w. 3.8-4 mm.

(Apr. (Fla.); Aug.) Mass. and N. Y., westw. to Ind. and Tenn., southw. to S. C., Ga. and Fla.

G. (*Lipophleps*) **pleuralis** (Will.)
1896. *Atarba pleuralis* Williston: Trans. Ent. Soc. London, 1896: 289.

Figs.—Williston, *Ibid.*, pl. 10, fig. 61 (ant., wing): 1896. Alexander, Ent. News, 23: 418-420, figs. 3-4 (hyp.); 1912. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 20 (wing); 1916.

Ga. and Fla., southw. into Neotropics.

G. (*Lipophleps*) **puer** Alex. (Fig. 47, G; 49, B).

1913. *Gonomyia* (*Leiponeura*) *puer* Alexander: Proc. U. S. Nat. Mus., 44: 506.

Figs.—Alexander, *Ibid.*, pl. 66, fig. 14 (ven.); 1913. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 21 (ven.), pl. 29, fig. 63 (hyp.); 1916.

Generally similar to *manca*; mesonotum dark grayish brown. Antennae uniformly dark. Wings iridescent with light blue and coppery reflexions. Male hypopygium (Fig. 49, B). ♂. L. 3.2-3.5 mm.; w. 2.8-3 mm. ♀. L. 4-4.5 mm.; w. 4-4.5 mm.

D. C., southw. to Ga., Fla. and Gr. Antilles.

G. (*Lipophleps*) **sacandaga** Alex.
1914. *Gonomyia* (*Leiponeura*) *sacandaga* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1914: 587.

Figs.—Alexander, *Ibid.*, pl. 26, fig. 21 (hyp.), pl. 27, fig. 25 (wing); 1914. Alexander, *Ibid.*, pl. 26, fig. 19 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 87 (wing); 1919.

General coloration yellow, variegated with brown; pleura conspicuously striped brown and yellow. Antennae with two basal segments yellow, flagellum brown. Halteres yellow. Femora brown. ♂. L. 3.2-3.5 mm.; w. 3.3-3.5 mm. ♀. L. about 4.5 mm.; w. 4 mm.

(June-Aug.) Vt., N. Y., westw. to Ind., Mich. and Mo., southw. to N. C.

G. (*Lipophleps*) **sulphurella** O. S. (Fig. 47, H).

1859. *Gonomyia sulphurella* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 230.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 2 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 24, fig. 3 (wing); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 26 (wing), pl. 29, fig. 70 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 91 (wing); 1919. Dickinson, Cfls. Wisc., p. 196, fig. 83 (wing); 1932.

Rostrum black. Antennae with two basal segments light yellow, flagellum black. Head light yellow: center of vertex darkened. Mesonotum dark brown, scutellum yellow; pleura striped longitudinally with sulphur-yellow and dark pruinose. Halteres sulphur-yellow. Femora with dark brown subterminal ring. Abdominal tergites dark brown, the caudal margins of segments conspicuously yellow. ♂. L. 3.5-4 mm.; w. 4-4.5 mm. ♀. L. about 4-4.5 mm.; w. 5-5.2 mm.

(May-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., N. J., Pa., westw. to Wisc., Kan. and Tex., southw. to Ga., Fla., Ala. and La.

Connecticut.—East River, July 11, 1910 (Ely); Granby, June 8, 1929 (C. P. A.); Hamden, July 8-Sept. 5, 1932 (N. T.); Kent Falls, July 23-24, 1931 (C. P. A.); Manitic Lake, Aug. 6, 1929 (C. P. A.); Middletown, June 17, 1909 (C. W. J.); Saptree Run State Park, June 14, 1933 (C. P. A.).

Subgenus **Idiocera** Dale

1842. *Limnobia* (*Idiocera*) Dale; Ann. Mag. Nat. Hist., 8: 431, 433.
1913. *Ptilostena* Bergroth; Ann. Mag. Nat. Hist., (8) 11: 575-576.

Key to Species

(Based in part on male characters)

1. Wings heavily patterned with dark brown, especially in the outer radial field ... 2
   Wings immaculate, except for the feebly indicated stigmal area 3
2. Male hypopygium with the outer lobe of basistyle short and stout, shorter than the outer dististyle; inner dististyle as shown (Fig. 49, D) ...... **blanda**
   Male hypopygium with the outer lobe of basistyle long and slender, longer than the outer dististyle; inner dististyle as shown (Fig. 49, E) .... **gaigei**
3. Male hypopygium with the outer arm of middle dististyle less than twice the flattened, paddle-shaped inner arm; inner dististyle with the spine at extreme apex; aedeagus not blackened and spinous at tip, the apex curved into a weak beak-like crook (Fig. 49, C) .... **apicispina**
   Male hypopygium with the outer arm of middle dististyle a long slender spine, the inner arm correspondingly reduced in size; inner dististyle with an acute spine on lateral margin at near two-thirds the length; aedeagus conspicuously blackened at apex, bearing powerful paired spines before tip (Fig. 49, F) .... **mathesoni**

Gonomyia (*Idiocera*) **apicispina** Alex. (Fig. 49, C).

1926. *Gonomyia* (*Ptilostena*) *apicispina* Alexander: Insec. Inscit. Menst. 14: 117-118.

Very similar to *mathesoni*, differing especially in the structure of the male hypopygium (Fig. 49, C). ♂. L. about 4 mm.; w. 5.2 mm. ♀. L. about 5.8 mm.; w. 6.3 mm.

(June) Ind.

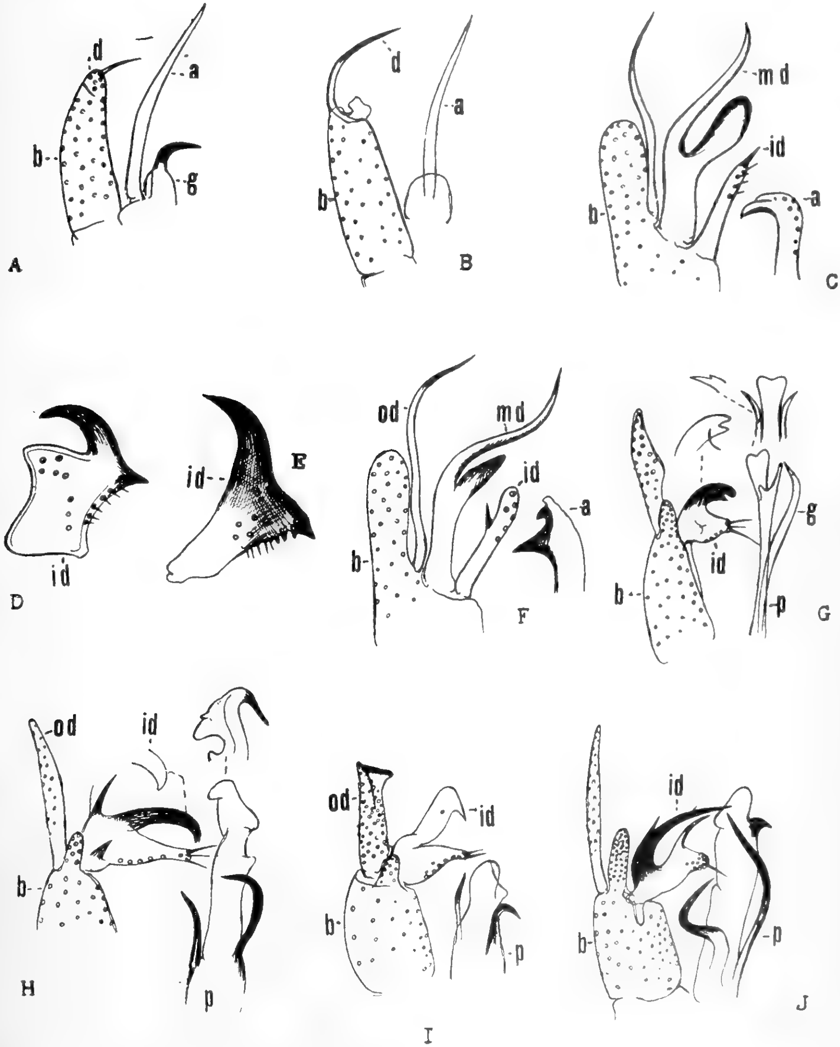


FIGURE 49. *Gonomyia;* male hypopygia.

A. *Gonomyia (Lipophleps) manca* (O. S.)
B. *G. (L.) puer* Alex.
C. *G. (Idiocera) apicispina* Alex.
D. *G. (I.) blanda* O. S.; *id.*
E. *G. (I.) gaigei* Rog.; *id.*
F. *G. (I.) mathesoni* Alex.
G. *G. (Gonomyia) bidentata* Alex.
H. *G. (G.) currani* Alex.
I. *G. (G.) mainensis* Alex.
J. *G. (G.) subcinerea* O. S.

Symbols: *a,* aedeagus; *b,* basistyle; *d,* dististyle; *g,* gonapophysis; *id,* inner dististyle; *md,* intermediate dististyle; *od,* outer dististyle; *p,* phallosome.

G. (*Idiocera*) **blanda** O. S. (Figs. 47, I; 49, D).
1859. *Gonomyia blanda* Osten Sacken, Proc. Acad. Nat. Sci. Philadelphia, 1859: 231.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 17 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 24, fig. 5 (wing); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 24 (wing), pl. 29, figs. 68, 69 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 90 (wing); 1919. Dickinson, Cfls. Wisc., p. 196, fig. 82 (wing); 1932.

Mesonotum grayish brown, the pleura more yellowish. Femora conspicuously darkened at tips. Wings (Fig. 47, I). Male hypopygium (Fig. 49, D). ♂. L. 4.2-4.5 mm.; w. 5.5 mm. ♀. L. 5.5-6 mm.; w. 6-7 mm.

(June, July) Ont., Que., N. S., N. H., Vt., Mass., N. Y., westw. to Mich., Wisc. and Mo., southw. to S. C., Ga. and n. Fla.

Connecticut.—East River, July 16-20, 1910 (Ely).

G. (*Idiocera*) **gaigei** Rog. (Fig. 49, E).
1931. *Gonomyia* (*Ptilostena*) *gaigei* Rogers; Pub. Univ. Oklahoma Biol. Surv., 3: 333-335.

Very close to *blanda* but distinct in the details of structure of the male hypopygium (Fig. 49, E). Vein *Sc* short.

(June) Okla.

G. (*Idiocera*) **mathesoni** Alex. (Fig. 49, F).
1915. *Gonomyia* (*Gonomyia*) *mathesoni* Alexander; Ent. News, 26: 170-172.

Figs.—Alexander, *Ibid.*, 26: 171, fig. 1 (wing), 2, 3 (hyp.); 1915. Alexander, Proc. Acad. Nat. Sci. Philadelphia, 518, pl. 26, fig. 23 (wing); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 89 (wing); 1919. Dickinson, Cfls. Wisc., p. 196, fig. 81 (wing); 1932.

General coloration yellow, the praescutum indistinctly striped with reddish brown. Pleura white, striped longitudinally with reddish brown. Wings subhyaline, the stigma barely indicated, veins R_{1+2} and R_3 approximated at margin. Abdominal tergites dark brown, the caudal margins narrowly yellow. Male hypopygium (Fig. 49, F). ♂. L. 5-5.4 mm.; w. 6-6.5 mm. ♀. L. 6.5-7 mm.; w. 6.2-7 mm.

(June-Aug.) N. S., N. H., Vt., Mass., Ct. and N. Y., westw. to Wisc., Mo. and Ia., southw. to N. C.

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

Subgenus **Gonomyia** Meigen

Key to Species
(Based chiefly on male characters)

1. Wings with cell *1st* M_2 open by atrophy of basal section of M_3 (*cognatella* group) 2
   Wings with cell *1st* M_2 closed (Fig. 47, J, K) 6

2. Male hypopygium with the inner arm of inner dististyle bifid (Fig. 48, C, E) 3
Male hypopygium with inner arm of inner dististyle simple (Fig. 48, B, D, F) 4
3. Male hypopygium with outer dististyle a very long slender rod, with only three or four setae; inner arm of inner dististyle very long and slender, the stem longer than the arms (Fig. 48, C) .... **cognatella**
Male hypopygium with the outer dististyle stouter, fringed along margin with several setae; inner arm of inner dististyle short, the stem stout, shorter than the arms (Fig. 48, E) .... **kansensis**
4. Outer dististyle a short powerful arm, dilated at apex, provided with setae; gonapophyses with a marginal spine that is directed caudad (Fig. 48, F) **reflexa**
Outer dististyle a long, sinuous, chitinized arm, without setae; gonapophyses produced into strong, erect, chitinized points (Fig. 48, A, B, D) 5
5. Gonapophyses small, the beak-like points feebly sclerotized; outer dististyle only slightly prolonged into an apical spine (Fig. 48, D) .... **florens**
Gonapophyses appearing as powerful, straight, heavily sclerotized spikes; outer dististyle produced into a powerful acute spine (Fig. 48, A, B) **armigera**
6. Wings with vein *Rs* shorter than R_{2+3+4}, the latter nearly straight; R_3 short and straight (Fig. 47, K) (*noveboracensis* group) .... **noveboracensis**
Wings with *Rs* subequal to or longer than the arcuated R_{2+3+4}; R_3 longer, gently sinuous (Fig. 47, J) (*subcinerea* group) 7
7. Male hypopygium with the outer dististyle short and stout, at apex nearly truncate, sclerotized; outer arm of inner dististyle entirely pale (Fig. 49, I) .... **mainensis**
Male hypopygium with the outer dististyle slender, the apex not sclerotized and only very obliquely truncated; outer arm of inner dististyle heavily blackened 8
8. Outer arm of inner dististyle obtuse and weakly bidentate at apex; gonapophyses equal in size, pale throughout (Fig. 49, G) .... **bidentata**
Outer arm of inner dististyle an acute spine; gonapophyses unequal in size, heavily blackened 9
9. Inner dististyle bearing two, or, in cases, three, blackened spines of various sizes, the outermost largest (Fig. 49, H) .... **currani**
Inner dististyle a single powerful black spine, basal in position, with a more slender outer pale spinous point (Fig. 49, J) .... **subcinerea**

The male genitalia of the members of the *cognatella* group (Fig. 48) show several features in common. There are two dististyles, the outer one simple but showing a considerable diversity of structure in the different species. Inner style very complex, divided into two principal arms, the longest of which is sometimes deeply split (*cognatella*, *kansensis*), in the other local species simple. The longest arm is strongly bent upon itself close to base and here is broken or fractured. Gonapophyses paired, compressed, variously lobed on lower margin. Aedeagus likewise compressed and variously lobed and notched on margin.

Gonomyia (*Gonomyia*) **armigera** Alex. (Fig. 48, A, B).
1922. *Gonomyia* (*Gonomyia*) *armigera* Alexander: Occas. Papers Mus. Zool. Univ. Michigan, 127: 4-5.

Cognatella group; rostrum and palpi black. Antennae with basal segments yellow; flagellum black. General coloration of mesonotum light brown; pleura yellow, with a conspicuous dark brown longitudinal stripe. Legs yellow. Abdominal tergites dark brown, the segments narrowly ringed caudally with yellow. Male hypopygium (Fig. 48, A, B). ♂. L. 4.8-5 mm.; w. 4.5-5 mm.

(June) N. Y., s. Ind.

G. (*Gonomyia*) **bidentata** Alex. (Figs. 49, G; 47, J).
1922. *Gonomyia* (*Gonomyia*) *bidentata* Alexander; *Ibid.*, 127: 3-4.

Subcinerea group; rostrum orange. A conspicuous brown spot on anepisternum. Male hypopygium (Fig. 49, G). ♂. L. 4.2-4.6 mm.; w. 5.5-5.8 mm. ♀. L. 4.8-5.4 mm.; w. 5.4-5.8 mm.

(July-Sept.) N. B., Me., N. H., Vt., Mass., N. Y., westw. and southwestw. to Ind. and Wisc.

Connecticut.—Kent Falls, July 23-24, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 6, 1928 (G. C. C.), Sept. 11, 1928 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.).

G. (*Gonomyia*) **cognatella** O. S. (Fig. 48, C).
1859. *Gonomyia cognatella* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 230.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 18 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 24, fig. 4 (wing); 1908. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 29 (wing), pl. 29, figs. 73-75 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 93 (ven.); 1919. Dickinson, Cfls. Wisc., p. 197, fig. 84 (wing); 1932.

Type of *cognatella* group; see general description under *armigera*. Male hypopygium (Fig. 48, C). ♂. L. about 4.5 mm.; w. 4.5-5 mm.

(June, July) Ct., N. Y., westw. to Wisc., Ia. and Mo., southw. to Va., S. C., Ind. and Ill.

Connecticut.—East River, July 5, 1910 (Ely).

G. (*Gonomyia*) **currani** Alex. (Fig. 49, H).
1926. *Gonomyia* (*Gonomyia*) *currani* Alexander; Can. Ent., 58: 239.

Subcinerea group. Rostrum light yellow; head dark gray. Praescutum with three confluent grayish brown stripes; scutellum yellow. Wings with Sc_1 ending some distance beyond origin of *Rs*. Male hypopygium (Fig. 49, H). ♂. L. 3.8-4 mm.; w. 4.5-4.8 mm. ♀. L. 5-5.4 mm.; w. 6.2-6.5 mm.

(Late May, June) Ont., Mass., Ct., N. Y., southw. to N. C.

Connecticut.—Middletown, May 31, 1929 (R. C. N.).

G. (*Gonomyia*) **mainensis** Alex. (Fig. 49, I).
1919. *Gonomyia* (*Gonomyia*) *mainensis* Alexander; Can. Ent., 51: 163.

Subcinerea group. Thoracic pleura light yellow, distinctly striped with purplish brown. Male hypopygium (Fig. 49, I). ♂. L. about 5 mm.; w. 5.6 mm.

(Aug.) Me.

G. (*Gonomyia*) **kansensis** Alex. (Fig. 48, E).
1918. *Gonomyia* (*Gonomyia*) *kansensis* Alexander; *Ibid.*, 50: 158-160.

Cognatella group. Male hypopygium (Fig. 48, E). ♂. L. about 4.5-4.6 mm.; w. 4.7-4.8 mm.

(May, June) Ind., Ill. and Mich., westw. to Kans., Mo. and Okla.

G. (*Gonomyia*) **florens** Alex. (Fig. 48, D).
1916. *Gonomyia* (*Gonomyia*) *florens* Alexander: *Ibid.*, 48:316-317.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 28 (wing), pl. 29, fig. 71 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 92 (wing); 1919.

Cognatella group. Male hypopygium (Fig. 48, D). ♂. L. 4-4.2 mm.; w. 5.2-5.7 mm. ♀. L. about 5.6-5.8 mm.; w. 6.6-6.8 mm.

(June) Ont., Que., Vt., N. Y., westw. to Ind., Ill. and Mich., southw. to N. C. and Tenn.

G. (*Gonomyia*) **noveboracensis** Alex. (Fig. 47, K).
1916. *Gonomyia* (*Gonomyia*) *noveboracensis* Alexander: *Ibid.*, 48: 319-320.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 30 (wing), pl. 30, figs. 79-80 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 92 (wing); 1919.

Type of *noveboracensis* group. Antennae black throughout; head gray. Pleura yellowish white with two brown stripes. Wings with vein R_3 short and oblique; cell *1st* M_2 closed (Fig. 47, K). Male hypopygium with a complicated development of structures surrounding the phallosome. ♂. L. about 3.8-4 mm.; w. 4.5-4.8 mm. ♀. L. about 5 mm.; w. about 4.5 mm.

(June) S. shore of Gaspé, Que., westw. to Mich. and Ind., southw. to Vt., Mass. and N. Y.

An isolated group, including also *aciculifera* Alex. (w. N. Amer.) and *edwardsi* Lacks. (n. c. Europe).

G. (*Gonomyia*) **reflexa** Alex. (Fig. 48, F).
1927. *Gonomyia* (*Gonomyia*) *reflexa* Alexander: Journ. N. Y. Ent. Soc., 35: 59-60.

Cognatella group. Male hypopygium (Fig. 48, F). ♂. L. about 4 mm.; w. 4.6-5.2 mm. ♀. L. about 5 mm.; w. about 5 mm.

(July) Mich.

G. (*Gonomyia*) **subcinerea** O. S. (Fig. 49, J).
1859. *Gonomyia subcinerea* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 231.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 4 (wing); 1869. Alexander, Proc. Acad. Nat. Sci. Philadelphia, pl. 26, fig. 33 (wing), pl. 26, figs. 83-85 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 36, fig. 95 (wing); 1919.

Type of *subcinerea* group. Brown to grayish brown, variegated with sulphur-yellow to pale yellow. Rostrum obscure yellow. Thoracic pleura pale yellow, with a small dark spot on laterocervix and propleura only. Abdominal tergites yellow, with large dark brown central areas. Male hypopygium (Fig. 49, J). ♂. L. 4.8-5.5 mm.; w. 5-6 mm. ♀. L. about 5.5-6 mm.; w. 5-6 mm.

(June-Sept.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Sask., Mont., Kan. and Mo., southw. to S. C., Ga. and n. Fla.

Connecticut.—East River, July 3, 1910 (Ely); Granby, June 8, 1929 (C. P. A.); Hartland, June 8, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Manitic Lake, Aug. 6, 1929 (C. P. A.); Middletown, June 16, 1909 (C. W. J.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Tyler Lake, May 30, June 13, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

3. Subtribe Eriopteraria

Rhabdomastix Skuse

1889. *Rhabdomastix* Skuse; Proc. Linn. Soc. New South Wales, (2) 4: 828-829.

Subgenus **Sacandaga** Alexander

1911. *Sacandaga* Alexander; Ent. News, 22: 351-352.

The subgenus *Sacandaga* is represented in our fauna by but few species. Adults may be swept from rank herbage along the margins of streams, where they appear in small swarms at dusk. Of these species, *flava* and *hudsonica* are found along larger streams or rivers; *brittoni* and *subarctica* along margins of brooks or minor streams. The immature stages occur in wet earth.

Key to Species

1. Vein R_2 present as a weak element; *m-cu* at or close to fork of M (Fig. 47, M); northern to Arctic 2
   Vein R_2 lacking; *m-cu* from one-third to one-half its own length beyond the fork of M (Fig. 47, L) 3
2. Veins R_3 and R_4 strongly divergent, cell R_3 at margin nearly twice as wide as cell R_2; vein R_3 short, about two-fifths R_4; macrotrichia of veins scanty, there being none on R_3, R_{3+4} or R_{2+3+4} .... **caudata**
   Veins R_3 and R_4 only slightly divergent, cell R_3 at margin subequal in extent to cell R_2; vein R_3 long, oblique in position, nearly one-half as long as R_4 (Fig. 47, M); macrotrichia of veins abundant, occurring on R_3, R_{3+4}, R_{2+3+4} and on the distal third of Rs .... **subarctica**
3. Size large (wing, ♂, 7.5-8.5 mm.); general coloration yellow, the head and thorax conspicuously patterned with grayish brown .... **hudsonica**
   Size smaller (wing, ♂, not exceeding 7 mm.); general coloration yellow, unmarked except for reddish brown thoracic areas, when these are present 4
4. Size small (wing, ♂, about 5 mm.); coloration clear sulphur-yellow; vein R_4 of wings gently curved, provided with scanty macrotrichia; wings hyaline, without stigma; veins pale and but little conspicuous (Fig. 47, L) **brittoni**
   Size larger (wing, ♂, 6.5-7 mm.); coloration ochreous-yellow, the praescutum with reddish stripes; vein R_4 of wings long and nearly straight, usually without macrotrichia (a very few scattered ones occurring in rare cases); wings hyaline, the stigma pale brown but usually evident; veins pale brown, distinct .... **flava**

Rhabdomastix (*Sacandaga*) **brittoni** Alex. (Fig. 47, L).

1933. *Rhabdomastix* (*Sacandaga*) *brittoni* Alexander; Journ. N. Y. Ent. Soc., 41: 93.

Macrotrichia on distal half of the gently curved vein R_4. ♂. L. 4-4.2 mm.; w. 4.8-5 mm. ♀. L. 5.5 mm.; w. 5.5 mm.

(July) N. H., Mass., Ct. (Transition).

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); types.

R. (*Sacandaga*) **caudata** (Lundb.)
1898. *Goniomyia* (*Empeda*) *caudata* Lundbeck: Vidensk. Meddel. fra den naturh. Foren., Copenhagen, 1898: 267, pl. 6, fig. 18 (wing).

Fig.—Alexander, Cfls. N. Y., 1, pl. 36, fig. 96 (wing); 1919.

Greenland, Baffinland. (Arctic).

R. (*Sacandaga*) **flava** (Alex.)
1911. *Sacandaga flava* Alexander; Ent. News, 22: 351-352.

Figs.—Alexander, *Ibid.*, *22*: 349, fig. 1 (head); 350, fig. 2 (tarsus); 352, fig. 3 (wing); 1911. Alexander, Cfls. N. Y., 1, pl. 36, fig. 97 (ven.); 1919.

Pleura variegated with reddish brown. Halteres and legs yellow. Wings iridescent. ♂. L. 5.5-6 mm.; w. 6.5-7 mm. ♀. L. 6-6.5 mm.; w. 6.5-7 mm.

(June, July) Que., N. S., N. H., Vt., Mass., Ct., N. Y., southw. to Tenn.

Connecticut.—W. Granby, June 8, 1929 (G. C. C.).

R. (*Sacandaga*) **hudsonica** Alex.
1933. *Rhabdomastix* (*Sacandaga*) *hudsonica* Alexander: Journ. N. Y. Ent. Soc., 41: 92-93.

Center of vertex, three praescutal stripes, centers of scutal lobes, posterior two-thirds of mediotergite and conspicuous areas on pleura grayish brown. Antennae black; scape yellow. Tips of femora and tibiae, and all tarsi, brownish black. Wings subhyaline; veins brown, conspicuous. ♂. L. 6-7 mm.; w. 7.5-8.5 mm. ♀. L. 7 mm.; w. 8.5 mm.

(June). Que.-N. Gaspé. (Hudsonian).

R. (*Sacandaga*) **subarctica** Alex. (Fig. 47, M).
1933. *Rhabdomastix* (*Sacandaga*) *subarctica* Alexander: Journ. N. Y. Ent. Soc., 41: 91-92.

♀. L. 4.5-5 mm.; w. 5-5.5 mm.

(June) Que.-N. Gaspé. (Hudsonian).

Symplecta Meigen

1825. *Helobia* St. Fargeau; Encycl. Method., Ins., 10: 585 (preocc.).
1830. *Symplecta* Meigen; Syst. Beschr. Zweifl. Ins., 6: 282.

A small group containing only seven species, of which one, *hybrida* Meigen, has a vast range throughout Eurasia, while a second, *cana* Walker, is similarly very wide-spread throughout North America, as far south as the mountains of Central America. The adult flies appear very early in the Spring, frequenting vegetation near water. The immature stages are to be found in saturated earth. Edwards has recently placed the present group as a subgenus of *Erioptera* and this appears to be its proper arrangement. It may be noted that as far as known there is but a single species in North America and this should

be called *cana*; the very numerous American records of *hybrida* all pertain to the species considered below.

Symplecta cana (Walker). (Fig. 47, N).
1804. *Limonia hybrida* Meigen; Klass., 1:57, pl. 3, fig. 17. (Erroneous for American records).
1818. *Limnobia punctipennis* Meigen; Syst. Beschr. Zweifl. Ins., 1: 147. (Erroneous for American records).
1848. *L. cana* Walker; List Dipt. Brit. Mus., 1:48.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 20 (wing); 1869. Snodgrass, Journ. N. Y. Ent. Soc., 11, pl. 11, fig. 15 (ovipos.); 1903. Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 8, figs. 10, 12 (hyp.); 1904. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 24, fig. 1 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3, fig. 23 (entire insect), fig. 25, sub 21 (wing); 1908. Alexander, Cfls. N. Y., 1, pl. 37, fig. 98 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 2; pl. 3, fig. 12 (thorax); 1925. Dickinson, Cfls. Wisc., p. 194, fig. 78 (wing); 1932.

General coloration gray, the praescutum with three brown stripes. Wings subhyaline, with a very restricted grayish brown pattern that is confined to the vicinity of the veins (Fig. 47, N). ♂. L. 4-5 mm.; w. 5-6 mm. ♀. L. 5-7 mm.; w. 5.5-8 mm.

(Late Feb. and Mar., into Spring; recurring in Fall) Almost universally distributed throughout the United States and Canada.

Connecticut.—East River, July 16, 1911 (Ely); Granby, Sept. 4, 1928 (G. C. C.); Hamden, Mar. 30, 1930 (R. B. F.); Middletown, Apr. 4-7, 1929 (R. C. N.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.).

Trimicra Osten Sacken

1861. *Trimicra* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861:290.

A small genus, including a single wide-spread species, *pilipes* (Fabr.), with other closely allied species, or perhaps races, in many parts of the World. I am considering the local fly as being a subspecies of *pilipes*. Similar representatives of the genus occur virtually throughout the entire Globe, including many of the most remote oceanic islands. The early stages occur in wet earth, near water.

In many parts of the World, a surprising range in size and relative pilosity is to be found within members of this group. This has led to the belief that even in a restricted area two or more species occur, but all of these seem to refer to the single fly, *pilipes*.

Edwards now considers *Trimicra* as being a subgenus of *Erioptera*.

Trimicra pilipes anomala O. S. (Fig. 50, A).
1861. *Trimicra anomala* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1861:290.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 1 (wing); 1869 (as *pilipes*). Snodgrass, Trans. Amer. Ent. Soc., 30, pl. 8, fig. 9 (hyp.); 1904. Alexander, Cfls. N. Y., 1, pl. 37, fig. 99 (ven.); 1919.

General coloration buffy, the praescutum almost covered by three confluent gray stripes, with an additional velvety-black capillary median vitta. Pleura with brown and yellowish longitudinal lines. Legs

chiefly yellow, conspicuously hairy: femora with brown subterminal ring. Wings (Fig. 50, A) subhyaline, the veins more or less seamed with darker. Abdomen dark brown, the lateral and caudal margins of the tergites obscure yellow; hypopygium large, yellow. ♂. L. 6-8 mm.; w. 8-11 mm. ♀. L. 6-7 mm.; w. 6-8 mm.

(June-Sept.) Mass., R. I., N. Y., N. J., Md., westw. to Cal., southw. to Fla., Tex. and Mex. (Cosmopolitan).

Erioptera Meigen

1803. *Erioptera* Meigen; Illiger's Mag., 2:262.

A very extensive genus of small crane-flies, including many of our commonest and best-known species. Chiefly for the sake of convenience, the genus is divided into a number of subgenera, of which seven occur within our limits. These groups are based on usually slight venational features which are sometimes difficult to maintain. The adult flies occur on vegetation near water, the early stages living in moist earth in this same habitat. Besides the subgenera discussed below, Edwards has now placed the two preceding genera, *Symplecta* Meigen and *Trimicra* Osten Sacken, as subgenera in this major genus.

Key to Subgenera

1. Wings with cell R_3 short, vein R_3 shorter than the petiole of cell R_3; vein R_2 some distance before origin of vein R_3 (Fig. 50, B, C); antennae (♂) with very long verticils 2
   Wings with cell R_3 deep, vein R_3 longer than the petiole of cell R_3; vein R_2 lying distad of origin of vein R_3 (Fig. 50, D-H); antennal verticils not conspicuously lengthened 3
2. Wings with cell *1st* M_2 open by atrophy of m with $m\text{-}cu$ at fork of M; veins R_3 and R_4 generally parallel, cell R_3 having a normal *Erioptera* shape but shorter; at margin, cells R_2 and R_3 subequal in extent or with R_3 approximately twice R_2. (Fig. 50, B) .... **Erioptera: Empeda**
   Wings with cell *1st* M_2 closed, with $m\text{-}cu$ some distance beyond fork of M; veins R_3 and R_4 strongly diverging, cell R_3 having a *Gonomyia*-like shape; at margin, cell R_3 nearly three times as extensive as cell R_2 (Fig. 50, C) **Erioptera: Gonempeda**
3. Wings with vein *2nd A* arcuated, the distal portion being deflected strongly cephalad so cell *1st A* at midlength is usually as broad as, or broader than, it is at margin; cell *1st* M_2 opening into cell *2nd* M_2 by atrophy of m (Fig. 50, D) .... **Erioptera: Erioptera**
   Wings with Anal veins divergent, cell *1st A* being widest at margin; vein *2nd A* straight or essentially so; cell *1st* M_2 closed or open 4
4. Wings with cell *1st* M_2 open (Fig. 50, E) 5
   Wings with cell *1st* M_2 closed, the basal section of M_3 greatly exceeding m in length (Fig. 50, F-H) 6
5. Wings with cell *1st* M_2 opening into cell M_3 by atrophy of basal section of M_3 (Fig. 50, E) .... **Erioptera: Mesocyphona**
   Wings with cell *1st* M_2 opening into cell *2nd* M_2 by atrophy of m .... **Erioptera: Psiloconopa** (part)
6. Wings with a more or less complete spur from the angulated basal section of vein M_3 jutting basad, into cell *1st* M_2, sometimes completely dividing the cell (Fig. 50, G) .... **Erioptera: Hoplolabis**
   Wings without such a spur (Fig. 50, F, H) 7
7. Wings with cell *1st* M_2 small (Fig. 50, F); coloration of local species polished black and yellow .... **Erioptera: Psiloconopa** (part)
   Wings with cell *1st* M_2 very elongate, m lying far distad, the distal section of vein M_{1+2} shorter than the cell (Fig. 50, H) .... **Erioptera: Ilisia**

Subgenus **Empeda** O. S.

1869. *Empeda* Osten Sacken; Mon. Dipt. N. Amer., 4: 183-184.

A wide-spread group, with two species occurring in our limits. Very recently, Edwards has recognized the genus *Cheilotrichia* Rossi (Verz. Oesterreich. Dipt., 1848: 12) as valid and has placed the present subgenus, as well as the next, *Gonempeda* Alexander, as subgenera therein.

Key to Species

1. Wings subhyaline, immaculate; vein R_3 longer than R_{3+4} (Fig. 50, B) **stigmatica**

   Wings dusky gray with the stigma and a narrow clouding along cord pale brown; vein R_3 subequal to or shorter than R_{3+4} .... **noctivagans**

Erioptera (*Empeda*) **noctivagans** Alex.

1917. *Erioptera* (*Empeda*) *noctivagans* Alexander; Can. Ent., 49: 200-201.

Fig.—Alexander, *Ibid.*, 49: 203, pl. 12, fig. 5 (wing); 1917.

General coloration grayish brown, the humeral region of praescutum yellow. Halteres yellow. Legs brown. ♂. L. 3-3.2 mm.; w. 4.6-4.8 mm. ♀. L. 3.8-4 mm.; w. 5.5-5.8 mm.

(Oct.) Va., Fla. (Austral).

E. (*Empeda*) **stigmatica** (O. S.) (Fig. 50, B).

1869. *Empeda stigmatica* Osten Sacken; Mon. Dipt. N. Amer., 4: 184-185.

Figs.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 85 (ven.); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, fig. 11 (thorax); 1925.

General coloration brownish gray; pleura more buffy. Halteres yellow. Legs chiefly obscure yellow, the outer segments darkened. Abdomen pale brown; hypopygium yellow. ♂. L. 4-4.5 mm.; w. 4-4.5 mm. ♀. L. 4.5-5 mm.; w. 4.5-5 mm.

(May-Aug.) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., southw. to N. C. and Tenn.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Hartland, June 9, 1929 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.); Tyler Lake, June 13, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

Subgenus **Gonempeda** Alex.

1924. *Gonempeda* Alexander; Proc. U. S. Nat. Mus., 64, art. 10: 8.

A single species in the local fauna. The adult flies occur in swarms beneath trees and shrubs growing along small streams. The early stages presumably live in the saturated earth at the water's margin.

Edwards now considers that this subgenus, as well as *Empeda* Osten Sacken, are more properly subgenera of the Palearctic group *Cheilotrichia* Rossi.

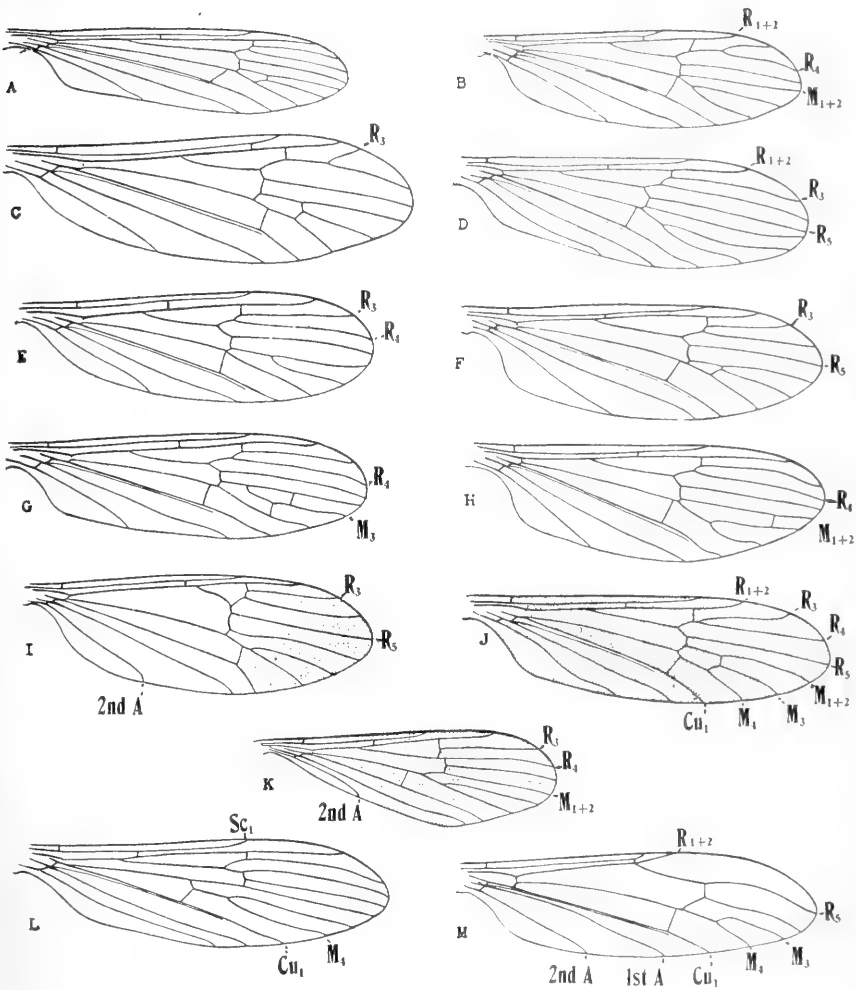


FIGURE 50. Eriopterini; venation.

A. *Trimicra pilipes anomala* O. S.
B. *Erioptera (Empeda) stigmatica* (O. S.)
C. *E. (Gonempeda) nyctops* Alex.
D. *E. (Erioptera) chrysocoma* (O. S.)
E. *E. (Mesocyphona) needhami* Alex.
F. *E. (Psiloconopa) cramptonella* (Alex.)
G. *E. (Hoplolabis) armata* O. S.
H. *E. (Ilisia) laevis* Alex.
I. *Cryptolabis (Cryptolabis) paradoxa* (O. S.)
J. *Osmosia nubila* (O. S.)
K. *Tasiocera (Dasymolophilus) niphadias* Alex.
L. *Molophilus cramptoni* Alex.
M. *Toxorhina (Toxorhina) muliebris* (O. S.)

Symbols: *A*, Anal; *Cu*, Cubitus; *M*, Media; *R*, Radius; *Sc*, Subcosta.

Erioptera (*Gonempeda*) **nyctops** Alex. (Figs. 50, C; 51, B).
1916. *Erioptera* (*Empeda*) *nyctops* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 503-505.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 36 (wing), pl. 31, fig. 98 (hyp.); 1916. Alexander, Cfls. N. Y., 1, pl. 35, fig. 84 (wing); 1919.

General coloration pale yellow throughout, only the eyes conspicuously black. Wings (Fig. 50, C) with *Sc* very long. Male hypopygium (Fig. 51, B) with the basistyle produced far beyond the level of apices of either dististyle, gradually narrowed to an acute point. ♂. L. 3.8-4 mm.; w. 4.3-4.5 mm. ♀. L. 3.8-4 mm.; w. 4.5-4.8 mm.

(Late May, June) Que., Me., N. H., Vt., N. Y., Ct., westw. to Mich., southw. to N. C. and Tenn.

Connecticut.—Hartland, June 9, 1929 (C. P. A.); Riverton, May 30, June 12, 1931 (C. P. A.); Tyler Lake, May 30, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

Subgenus **Erioptera** Meig.

Key to Species

(Based especially on male characters)

1. Knobs of halteres dark brown 2
   Halteres pale throughout 4
2. General coloration of body polished black; femora obscure yellow, the tips blackened; male hypopygium (Fig. 51, G) .... **ebenina**
   General coloration of body dull brown; legs brown or black 3
3. General coloration of mesonotum dull brown, the humeral region of praescutum scarcely brightened; pleura uniformly gray to brownish gray; male hypopygium with the inner dististyle a small simple structure that narrows gradually to a point (Fig. 52, E) .... **uliginosa**
   General coloration of mesonotum brown, the lateral and humeral portions of praescutum conspicuously brightened; pleura obscure yellow, striped longitudinally with dark brown; male hypopygium with a conspicuous spine on outer margin of outer dististyle at near midlength (Fig. 52, B) **septemtrionis**
4. Wings with small darkened spots on crossveins and deflections; outer costal field and cell R_2 suffused with darker; fore femora chiefly blackened, the coloration produced in large part by long black setae 5
   Wings unmarked; legs pale (more darkened in *villosa*) 6
5. Male hypopygium with the outer lobe of outer dististyle relatively slender; basal gonapophyses appearing as long straight spines (Fig. 51, E) **chrysocoma**
   Male hypopygium with the outer lobe of outer dististyle dilated; basal gonapophyses stout, at apex suddenly narrowed to an acute black spine that is surrounded by a group of setae (Fig. 51, F) ....**chrysocomoides**
6. General coloration of body and appendages pale green (*chlorophylla* group) 7
   General coloration of body and appendages yellow or brown, without green tinges 13
7. Male hypopygium with the gonapophyses appearing as smooth polished horns (Fig. 51, C, D, I) 8
   Male hypopygium with the gonapophyses appearing as flattened blades, the outer margin more or less serrulate (Figs. 51, H; 52, C, D, H) 10
8. Both dististyles slender, gradually narrowed to acute tips (Fig. 51, D) **chlorophylloides**
   Outer dististyle expanded into a paddle-like blade; inner style bearing a subterminal spinous point (Fig. 51, C, I) 9
9. Outer dististyle with the apex microscopically roughened; inner style with a small blackened spine on outer margin some distance from tip (Fig. 51, C) ....**chlorophylla**

Outer dististyle a dusky paddle-like blade, with smooth margins; inner style short and stout, with a small recurved spinous point at extreme tip (Fig. 51, I) .... **gaspeana**

10. Inner dististyle with a long spinous point placed far before apex, to give a forked appearance to style (Figs. 51, H; 52, D) 11
Inner dististyle not appearing forked at apex (Fig. 52, C, H) 12
11. Outer dististyle narrow, the extreme tip truncated and blackened; gonapophyses slender (Fig. 51, H) .... **furcifer**
Outer dististyle widened apically; gonapophyses heavily blackened, unusually broad, terminating in a spike-like point (Fig. 52, D) .... **subfurcifer**
12. Inner dististyle with a setiferous spine at right angles to extreme apex (Fig. 52, C) .... **subchlorophylla**
Inner dististyle without evident spine, the style appearing more or less foot-shaped, with a group of setae at the "heel." (Fig. 52, H) .... **viridula**
13. General coloration of body dark brown; wings strongly tinged with brown; male hypopygium (Fig. 52, G) .... **villosa**
General coloration of body light brown to pale yellow; wings yellow or only slightly infumed 14
14. Mesonotal praescutum with distinct reddish brown stripes; posterior sclerites of mesonotum and pleura pale yellow, variegated with brown or reddish brown; male hypopygium (Fig. 52, F) .... **vespertina**
Mesonotum and pleura uniformly pale yellow or orange 15
15. General coloration orange or orange-yellow; front and restricted posterior orbits silvery; male hypopygium (Fig. 52, A) with the outer dististyle an elongate paddle-like blade; gonapophyses appearing as long, straight, black spikes, lying generally parallel to one another, jutting caudad from the genital chamber .... **megophthalma**
General coloration pale yellow or whitish yellow; male hypopygium with both dististyles long and slender, subequal in length and size, their tips acute; gonapophyses short, bent at about a right angle into a long blackened spine that is not directed caudad .... **straminea**

The use of male genitalic characters is quite imperative in the case of many of the above species, notably those of the so-called *chlorophylla* group.

Erioptera (*Erioptera*) **chlorophylla** O. S. (Fig. 51, C).
1859. *Erioptera chlorophylla* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 16 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 35, fig. 75 (wing); 1919. Dickinson, Cfls. Wisc., p. 192, fig. 75 (wing); 1932.

Type of the *chlorophylla* group. General coloration pale green. Eyes (♂) holoptic beneath, separated above. Ovipositor with long smooth cerci. Male hypopygium (Fig. 51, C). ♂. L. 4-4.5 mm.; w. 5-5.5 mm. ♀. L. 5-5.5 mm.; w. about 6 mm.

(July, Aug.) Ont., Que., N. S., Me., N. H., N. Y., westw. to Ind. and Wisc., southw. to N. C., Tenn. and Fla.

Connecticut.—East River, July 9, 1910 (Ely); Hamden, July 12, 1932 (P. G.), July 31, 1928 (R. B. F.); Manitic Lake, Aug. 6, 1929 (C. P. A.); New Haven, Aug. 20, 1928 (G. B.).

E. (*Erioptera*) **chlorophylloides** Alex. (Fig. 51, D).
1919. *Erioptera chlorophylloides* Alexander: Bull. Brooklyn Ent. Soc., 14: 106-107.

Belongs to the *chlorophylla* group. General coloration pale green.

Eyes (♂) unusually large, broadly holoptic beneath. Ovipositor with cerci dark-colored, upcurved, the ventral margin microscopically serrulate. Male hypopygium (Fig. 51, D). ♂. L. 4.5 mm.; w. 5.8-6 mm. ♀. L. 5 mm.; w. 6.8-7 mm.

(June-early Aug.) Ont., Que., Me., Ct., westw. to Ill., Mich. and Colo., southw. to N. J. and Tenn.

Connecticut.—Manitic Lake, Aug. 6, 1929 (C. P. A.); Natchaug State Forest, June 14, 1933 (C. P. A.); Putnam, June 15, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.).

E. (*Erioptera*) **chrysocoma** O. S. (Figs. 50, D; 51, E).
1859. *Erioptera chrysocoma* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 74 (wing); 1919.

Mesonotum chiefly obscure yellow; pleura more infuscated. Legs chiefly darkened; middle and hind femora yellow, the tips narrowly darkened; tibiae and tarsi infuscated. Wings (Fig. 50, D) yellow, the costal border broadly more saturated, golden-yellow, this color produced by trichia; small but conspicuous brown dots at Sc_1, Sc_2, R_2, tip of R_{1+2} and along cord; vein *2nd A* only gently sinuate. Abdomen orange-yellow, with a narrow dark median line. Male hypopygium (Fig. 51, E). ♂. L. 4.5-5.5 mm.; w. 5-6 mm. ♀. L. 6 mm.; w. 6.5 mm.

(June-early Aug.) Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., southw. to Va. and N. C.

Connecticut.—Hamden, June 30, 1932 (N. T.); Natchaug State Forest, June 14, 1933 (C. P. A.); Riverton, June 12, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.).

E. (*Erioptera*) **chrysocomoides** Alex. (Fig. 51, F).
1929. *Erioptera* (*Erioptera*) *chrysocomoides* Alexander; Journ. N. Y. Ent. Soc., 37: 50-51.

Very similar to *chrysocoma*, differing conspicuously in the structure of the male hypopygium (Fig. 51, F). Anal veins more divergent, *2nd A* shorter. Outer radial field of wing more extensively suffused with darker. ♂. L. 4-4.5 mm.; w. 4.5-5 mm. ♀. L. 4.5 mm.; w. 4.5-5 mm.

(June, July) Mass., southw. to Tenn.

E. (*Erioptera*) **ebenina** Alex. (Fig. 51, G).
1926. *Erioptera* (*Erioptera*) *ebenina* Alexander; Can. Ent., 58: 237-238.

A very distinct and isolated species. Lateral pretergites light yellow; ventral pleurites silvery pruinose. Head dark gray. Ninth abdominal segment (♂) pale; hypopygium with the inner dististyle a short massive club (Fig. 51, G). ♂. L. 4-4.2 mm.; w. 5-5.5 mm. ♀. L. 4.2-4.5 mm.; w. 5-5.5 mm.

(Late May, June) Ont., N. Y., Ct.

Connecticut.—Manitic Lake, June 8, 9, 1929 (C. P. A.).

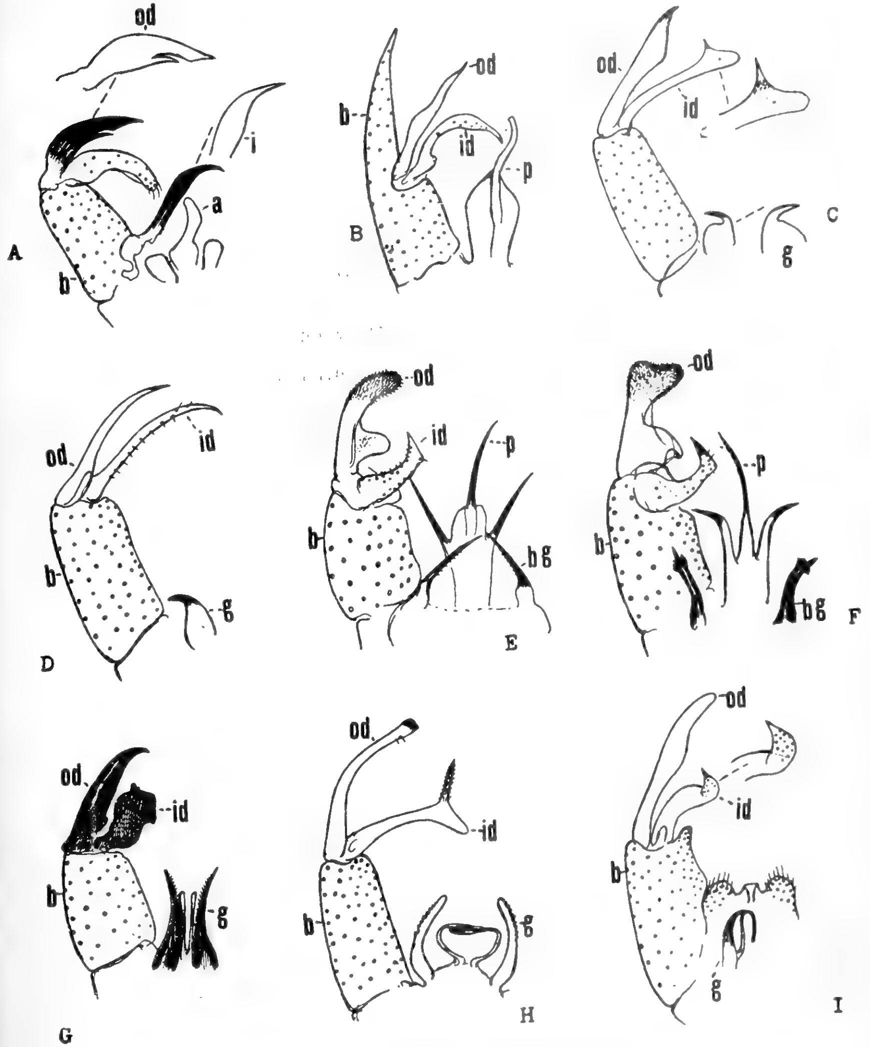


FIGURE 51. Eriopterini: male hypopygia.

A. *Lipsothrix sylvia* (Alex.)
B. *Erioptera (Gonempeda) nyctops* Alex.
C. *E. (Erioptera) chlorophylla* O. S.
D. *E. (E.) chlorophylloides* Alex.
E. *E. (E.) chrysocoma* O. S.
F. *E. (E.) chrysocomoides* Alex.
G. *E. (E.) ebenina* Alex.
H. *E. (E.) furcifer* Alex.
I. *E. (E.) gaspeana* Alex.

Symbols: *a*, aedeagus; *b*, basistyle; *bg*, basal gonapophysis; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome.

E. (*Erioptera*) **furcifer** Alex. (Fig. 51, H).
1919. *Erioptera furcifer* Alexander: Bull. Brooklyn Ent. Soc., 14: 108.

Belongs to the *chlorophylla* group. General coloration pale green. Ovipositor with the cerci long and slender, with smooth margins. Male hypopygium (Fig. 51, H). ♂. L. about 4.8-5 mm.; w. 5.2-5.5 mm. ♀. L. about 5 mm.; w. 5 mm.

(Late June, July) Ont., Mass., N. J., westw. to Mich., southw. to Md., S. C. and Tenn.

Connecticut.—Hamden, July 11-13, Aug. 1, 1932 (P. G.); Woodmont, July 9, 1904 (P. L. B.).

E. (*Erioptera*) **gaspeana** Alex. (Fig. 51, I).
1929. *Erioptera* (*Erioptera*) *gaspeana* Alexander; Can. Ent., 61: 250-251.

Belongs to the *chlorophylla* group. General coloration very pale green. Ovipositor with the cerci slender, with smooth margins. Male hypopygium (Fig. 51, I). ♂. L. about 5-5.5 mm.; w. 5-5.5 mm. ♀. L. about 6 mm.; w. 6.5 mm.

(Late June-Aug.) Que., westw. to Mich.

E. (*Erioptera*) **megophthalma** Alex. (Fig. 52, A).
1918. *Erioptera* (*Erioptera*) *megophthalma* Alexander; Can. Ent., 50: 60-61.

Eyes (♂) very large, black. Antennal scape and pedicel dark, flagellum pale basally, the outer segments darkened. Head yellow, the front and posterior orbits more silvery. Halteres and legs pale, the knobs of former a trifle darkened. Male hypopygium (Fig. 52, A). ♂. L. 4.5-5 mm.; w. 4.5-5.2 mm. ♀. L. 5.5 mm.; w. 5.5 mm.

(June) Ont., Que., Me., Vt., N. Y., Pa., westw. to Mich., southw. to N. C. and Tenn.

Connecticut.—Norfolk, June 9, 1929 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

E. (*Erioptera*) **septemtrionis** O. S. (Fig. 52, B).
1859. *Erioptera septemtrionis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.

Figs.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 72 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, fig. 10 (thorax); 1925. Dickinson, Cfls. Wisc., p. 192, fig. 73 (wing); 1932.

Trichia of wing-veins unusually short; vein *2nd A* strongly sinuous. Male hypopygium (Fig. 52, B). ♂. L. 4-4.5 mm.; w. 4.5-5.5 mm. ♀. L. 5-5.5 mm.; w. 5-5.5 mm.

(Apr.-Sept.) Ont., Que., N. B., N. S., Me., Vt., N. H., Mass., N. Y., westw. to Mich., Wisc., Ia. and Kan., southw. to Ga., n. Fla. and Ala.

Connecticut.—Hamden, July 8, Aug. 24, 1932 (N. T.), July 12, 1932 (P. G.); Kent Falls, Sept. 11, 1929 (A. J. W.); Middletown, May 26, 1929 (R. C. N.); Norfolk, May 31, 1916 (W. L. M.), June 9, 1929 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.); Stamford, May 16, 1929 (B. T. R. L.); Tyler Lake, May 17, 1931 (C. P. A.); Union, Aug. 17-18, 1928 (C. F. C.).

E. (*Erioptera*) **straminea** O. S.
1869. *Erioptera straminea* Osten Sacken; Mon. Dipt. N. Amer., 4: 157.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 76 (wing); 1919.

Eyes (♂) large, holoptic beneath. Ovipositor with cerci short, strongly upcurved, dark-colored, the ventral margins smooth. The male hypopygium is much as in *chlorophylloides*, but with slightly different gonapophyses. ♂. L. 4-4.5 mm.; w. 4.5-5 mm. ♀. L. 5 mm.; w. 5.5 mm.

(Late May-July) Que., Me., Vt., Mass., N. Y., westw. to Mich., Ind. and Ill., southw. to S. C.

Johnson's record of this species is erroneous; see *vespertina*.

E. (*Erioptera*) **subchlorophylla** Alex. (Fig. 52, C).
1919. *Erioptera subchlorophylla* Alexander: Bull. Brooklyn Ent. Soc., 14: 107-108.

Belongs to the *chlorophylla* group. Wings yellowish, veins greenish yellow. Male hypopygium (Fig. 52, C). ♂. L. about 4 mm.; w. 4.5 mm.

(May-July) Mass. (Cape Cod), N. J., southw. to Fla. (Austral).

E. (*Erioptera*) **subfurcifer** Alex. (Fig. 52, D).
1929. *Erioptera* (*Erioptera*) *subfurcifer* Alexander; Journ. N. Y. Ent. Soc., 37: 51.

Belongs to the *chlorophylla* group. Thoracic stripes ferruginous; wings yellowish, the veins greenish-yellow. Male hypopygium (Fig. 52, D). ♂. L. about 5-5.5 mm.; w. 5.5 mm. ♀. L. 6-7 mm.; w. 6.5-7 mm.

(June) Ct., westw. to Mich. (Canadian).

Connecticut.—State Line Pond, near Stafford Springs, June 14, 15, 1933 (C. P. A.); Putnam, June 15, 1933 (C. P. A.). In sphagnum bogs.

E. (*Erioptera*) **uliginosa** Alex. (Fig. 52, E).
1930. *Erioptera* (*Erioptera*) *uliginosa* Alexander; Occas. Papers Boston Soc. Nat. Hist., 5: 277-278.

Legs brown. Wings with a strong brown suffusion, more saturated in the costal and stigmal regions. Ovipositor with cerci long and slender, the margins smooth. Male hypopygium (Fig. 52, E). ♂. L. about 4.5-4.8 mm.; w. 4.5-5.3 mm. ♀. L. about 5 mm.; w. 5.3-5.5 mm.

(June) Me., Ct., westw. to Mich. and Wisc., in sphagnum bogs. (Canadian).

Connecticut.—Manitic Lake, June 8, 9, 1929 (C. P. A.).

E. (*Erioptera*) **vespertina** O. S. (Fig. 52, F).
1859. *Erioptera vespertina* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.

FIGURE 52. Eriopterini: *Erioptera;* male hypopygia.

A. *Erioptera (Erioptera) megophthalma* Alex.

B. *E. (E.) septemtrionis* O. S.

C. *E. (E.) subchlorophylla* Alex.

D. *E. (E.) subfurcifer* Alex.

E. *E. (E.) uliginosa* Alex.

F. *E. (E.) vespertina* O. S.

G. *E. (E.) villosa* O. S.

H. *E. (E.) viridula* Alex.

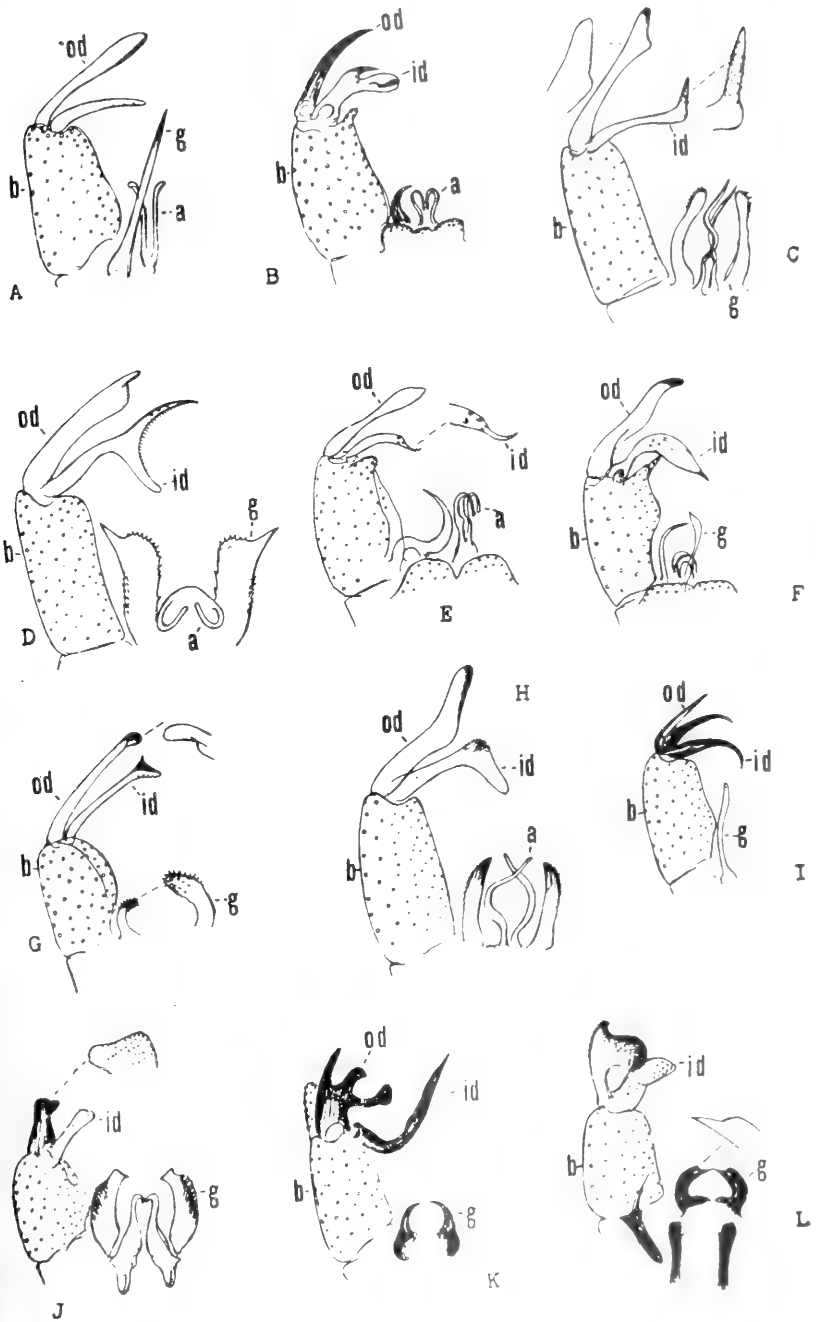
I. *E. (Mesocyphona) caloptera* Say

J. *E. (Psiloconopa) cramptonella* (Alex.)

K. *E. (Hoplolabis) armata* O. S.

L. *E. (Ilisia) armillaris* O. S.

Symbols: *a,* aedeagus; *b,* basistyle; *g,* gonapophysis; *id,* inner dististyle; *od,* outer dististyle.


od
id
g
a
b
A
B
C
D
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1921. *Erioptera holoptica* Dietz; Trans. Amer. Ent. Soc., 47:245-246.
1921. *Erioptera holoptica fuscoantennata* Dietz; *Ibid.*, 47:246.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 20 (hyp.); 1869. Alexander, Cfls. N. Y., 1, pl. 35, fig. 73 (wing); 1919. Dickinson, Cfls. Wisc., p. 192, fig. 74 (wing); 1932.

Humeral and lateral regions of praescutum broadly yellow; median region of scutum with a capillary brown line; scutellum yellow, with a dark basal spot; postnotal mediotergite darkened; pleura yellow, variegated with reddish brown. Eyes (♂) very large. Legs yellow. Wings rather strongly suffused with brownish. Hypopygium brighter than remainder of abdomen (Fig. 52, F). ♂. L. 4.5-5 mm.; w. 4-5 mm. ♀. L. 5-5.5 mm.; w. 5-5.5 mm.

(May, July) Ont., Que., Me., N. H., Vt., Mass., N. Y., Pa., westw. to Ill., Ia. and Wisc., southw. to S. C., Fla. and Ala.

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Woodmont, July 9, 1904 (P. L. B.) determined by Johnson as *straminea*.

E. (*Erioptera*) **villosa** O. S. (Fig. 52, G).
1859. *Erioptera villosa* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859:226.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 23, fig. 1 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 35, fig. 71 (wing); 1919.

General coloration dark brown, the humeral and lateral portions of praescutum restrictedly brightened. Legs brownish yellow. Wings with a strong brown suffusion, the costal and stigmal regions more saturated; vein *2nd A* strongly sinuous. Ovipositor with cerci slender, strongly upcurved, margins smooth. Male hypopygium (Fig. 52, G) scarcely brightened. ♂. L. about 5-5.5 mm.; w. 6-6.5 mm. ♀. L. 5.5-6.5 mm.; w. 6-6.5 mm.

(June, early July) Que., Ont., N. B., N. Y., westw. to Sask., Alta., Wyo. and Utah. (Hudsonian, Canadian).

E. (*Erioptera*) **viridula** Alex. (Fig. 52, H).
1929. *Erioptera* (*Erioptera*) *viridula* Alexander; Can. Ent., 61:20.

Belongs to the *chlorophylla* group. General coloration pale green throughout. Ovipositor with long slender cerci, their margins smooth. Male hypopygium (Fig. 52, H). ♂. L. 4.5-5 mm.; w. 5-6 mm. ♀. L. 5-6 mm.; w. 6-7 mm.

(June, early July) Ont., Que., N. H., Vt., Ct., N. Y. (Canadian).

Connecticut.—Stafford Springs, June 14, 1933 (C.P.A.).

Subgenus **Mesocyphona** O. S.

1869. *Erioptera* (*Mesocyphona*) Osten Sacken; Mon. Dipt. N. Amer., 4:161.

Key to Species

1. Wings with a faint brown tinge, the cord and veins at margin with small darker spots; size very small (w., ♂, about 2.5 mm.) .... **parva**

Wings with a strong brown tinge, variegated with numerous white spots and dots; size larger (w., ♂, about 3.5 mm. or more) 2

2. Femora with two brown rings; wings with about a score of large white spots, with additional smaller dots in all cells .... **caloptera**

Femora with a single brown subterminal ring; wings with about a score of large white spots but without additional pale dots in the cells ...... **needhami**

Erioptera (*Mesocyphona*) **caloptera** Say (Fig. 52, I).

1823. *Erioptera caliptera* Say; Journ. Acad. Nat. Sci. Philadelphia, 3:17.

1828. *Erioptera caloptera* Wiedemann: Aussereur. Zweifl. Ins., 1:23.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 4, fig. 15 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 23, fig. 3 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 35, fig. 77 (wing); 1919. Dickinson, Cfls. Wisc., p. 192, fig. 72 (wing); 1932.

Mesonotal praescutum light buffy gray, with two narrow dark brown stripes; pleura conspicuously striped with silvery. Femoral dark rings subequal to or narrower than interspace. Male hypopygium (Fig. 52, I). ♂. L. 3.5-4 mm.; w. 3.5-4 mm. ♀. L. 4-4.5 mm.; w. 4-4.5 mm.

(May-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., R. I., N. Y., westw. to Mo. and Colo., southw. to S. C., Fla. and Ala. (Tropical America, as races).

Connecticut.—Branford, June 23, Aug. 11, 1904 (H. L. V.); Granby, June 8, 1929 (C. P. A.); Hamden, July 8, Aug. 24, Sept. 2, 1932 (N. T.), Aug. 1, 1932 (P. G.); Kent Falls, June 12-13, July 23-24, 1931 (C. P. A.), Sept. 11, 1929 (A. J. W.); Meriden, July 30, 1929 (B. H. W.); New Haven, Aug. 20, 1928 (G. B.); Norfolk, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); W. Hartford, June 23, Aug. 11, 1904 (H. L. V.); Winsted, Sept. 5, 1928 (G. C. C.), June 9, 1929 (C. P. A.).

E. (*Mesocyphona*) **needhami** Alex. (Fig. 50, E).

1918. *Erioptera* (*Mesocyphona*) *needhami* Alexander: Can. Ent., 50:383-384.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 78 (wing); 1919.

Generally similar to *caloptera*. Wings with about twenty white spots, distributed along the cord and as marginal areas at ends of veins; venation (Fig. 50, E). ♂. L. 3-3.5 mm.; w. 3.5-4 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., westw. to Mich., Ill. and Mo., southw. to S. C., Ga. and Fla.

Connecticut.—Hamden, July 12, 1932 (P.G.); Kent Falls, July 23-24, 1931 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.).

E. (*Mesocyphona*) **parva** O. S.

1859. *Erioptera parva* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859:227.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 79 (wing); 1919.

Legs yellow, the femora with a narrow brown subterminal ring. ♂. L. about 2.5 mm.; w. 2.5 mm. ♀. L. about 3 mm.; w. 3.5 mm.

(June, July) Ct., N. Y., westw. to Mich., Ia., Mo. and Kan., southw. to Ga., Ala. and Fla. (Neotropics).

Connecticut.—Hamden, June 30, 1932 (N. T.); recorded from Connecticut by C. W. Johnson.

Subgenus **Psiloconopa** Zetterstedt

1838. *Psiloconopa* Zetterstedt; Ins. Lapponica, Dipt., p. 847.

A northern group, including several diverse types that do not fit well into any of the other subgeneric divisions of *Erioptera.*

Key to Species

1. Wings with cell *1st* M_2 closed (Fig. 50, F); general coloration of body polished black, variegated with bright yellow .... **cramptonella**
   Wings with cell *1st* M_2 open by atrophy of *m* 2
2. Wings with a brownish yellow tinge, but not otherwise patterned .... **gaspicola**
   Wings with a restricted brown pattern 3
3. Wings pale yellowish subhyaline, with two broad brown crossbands, one before, the other immediately beyond the cord; wings narrow, the forks of cells beyond cord deep; *m-cu* some distance before fork of *M* **manitobensis**
   Wings yellowish, the veins streaked longitudinally with brown; wings broad, the forks of the cells beyond cord shallow; *m-cu* at fork of *M*..... **painteri**

Erioptera (*Psiloconopa*) **cramptonella** (Alex.) (Figs. 50, F; 52, J).
1931. *Psiloconopa cramptonella* Alexander; Can. Ent., 63: 144-145.

Abdominal segments ringed caudally with sulphur-yellow. Halteres light yellow. Legs black. Wings (Fig. 50, F) strongly tinged with dusky; cell *1st* M_2 small. Male hypopygium (Fig. 52, J). ♂. L. 3.2-3.5 mm.; w. 3.8-4.4 mm. ♀. L. about 4 mm.; w. 4.5-4.6 mm.

(June) E. Que. (Gaspé), Prince Edward Island (Marion E. Smith).

E. (*Psiloconopa*) **gaspicola** (Alex.)
1929. *Psiloconopa gaspicola* Alexander; Journ. N. Y. Ent. Soc., 37: 54-55.

General coloration dull dark gray. Halteres pale yellow. Wings brownish yellow, the base and costal region clearer yellow; veins stout. ♂. L. about 5.5 mm.; w. 5.2 mm.

(June) E. Que. (Gaspé), westw. to Colo.

E. (*Psiloconopa*) **manitobensis** Alex.
1929. *Erioptera* (*Ilisia*) *manitobensis* Alexander; Journ. N. Y. Ent. Soc., 37: 51-52.

General coloration dull gray, the praescutum with four brown stripes. Antennae black throughout. Halteres yellow. Femora brown, their bases yellowish; tibiae pale brown; tarsi darker. Anal veins divergent. ♂. L. about 4 mm.; w. 5 mm.

(June) Man.

E. (*Psiloconopa*) **painteri** Alex.
1929. *Erioptera painteri* Alexander; Can. Ent., 61: 19-20.

General coloration brownish gray, the praescutum with three brown stripes, the median stripe more or less divided medially. Halteres yellow. Legs brownish black. Anal veins divergent. ♂. L. about 5.5 mm.; w. 5 mm.

(May) Ohio

Subgenus **Hoplolabis** O. S.

1869. *Erioptera* (*Hoplolabis*) Osten Sacken: Mon. Dipt. N. Amer., 4: 160.

The subgenus finds its near ally in *Ilisia*. A single local species, with a few others in western North America and in Japan.

Erioptera (*Hoplolabis*) **armata** O. S. (Figs. 50, G; 52, K).
1859. *Erioptera armata* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 227.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 18 (wing), pl. 4, fig. 14 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 23, figs. 5, 6 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 35, fig. 83 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 5 (thorax); 1925. Dickinson, Cfls. Wisc., p. 193, fig. 76 (wing); 1932.

General coloration gray, the praescutum with black setigerous punctures on the interspaces. Knobs of halteres darkened. Legs obscure yellow. Wings with a heavy dark brown pattern, arranged chiefly as four or five major costal areas, with smaller spots at ends of other longitudinal veins and on crossveins and deflections; basal section of vein M_3 angulated and spurred, the spur extending basad into cell *1st* M_2, sometimes complete (Fig. 50, G). Abdomen dark brown, the segments ringed caudally with pale. Male hypopygium (Fig. 52, K). ♂. L. 4.5-5.5 mm.; w. 5-6 mm. ♀. L. 5-6 mm.; w. 5.5-6.5 mm.

(May-Sept.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., westw. to Ia., Okla. and Colo., southw. to S. C., Ga. and Tenn.

Connecticut.—Hamden, Sept. 5, 1932 (N. T.); Hartland, June 9, 1929 (C. P. A.); Kent Falls, Sept. 11, 1929 (A. J. W.); Norfolk, May 31, 1931, June 9, 1929 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Twin Lakes, Sept. 12, 1928 (G. C. C.); Tyler Lake, May 30, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); W. Hartford, Aug. 29, 1904 (H. L. V.).

Subgenus **Ilisia** Rond.

1856. *Ilisia* Rondani; Prodr. Dipterol. Italicae, 1: 182.
1869. *Erioptera* (*Acyphona*) Osten Sacken: Mon. Dipt. N. Amer., 4: 151-152.

The various species have cell *1st* M_2 unusually long, with the basal section of M_3 nearly straight, not angulated and spurred as in *Hoplolabis*.

Key to Species

1. Wings with two broad brown crossbands, the first not attaining the costal border, the larger second band at the cord, these bands wider than the hourglass-shaped interspace .... **venusta**
   Wings with the dark pattern broken into small spots or narrow broken bands that are narrower than the interspace 2
2. All femora with a single narrow, dark brown, subterminal ring .... **indianensis**
   At least the fore femora with two broader rings 3
3. Femora with the dark rings nearly black, so broad as to include almost the entire segment, the usual ground-color reduced to a narrow pale annulus; base of tibia narrowly blackened .... **graphica**

At least the fore femora with two pale brown rings that do not exceed in extent the yellow annulus between 4

4\. General coloration of body dark, the thoracic notum grayish brown; male hypopygium with the outer margin of outer dististyle not emarginate; gonapophyses appearing as smooth, nearly straight, black horns .... **laevis**

General coloration of thoracic notum yellowish brown; male hypopygium (Fig. 52, L) with the outer dististyle very large, the head with its outer margin conspicuously emarginate; gonapophyses microscopically spinulose before the abruptly narrowed acute spinous apex .... **armillaris**

Erioptera (*Ilisia*) **armillaris** O. S. (Fig. 52, L).

1869\. *Erioptera armillaris* Osten Sacken; Mon. Dipt. N. Amer., 4: 158-159.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 81 (wing); 1919.

Thoracic pleura and posterior sclerites of mesonotum dark liver-brown, the praescutum conspicuously yellowish brown. Fore femora with two pale brown annuli; remaining femora with a single subterminal ring; tibiae entirely yellow. Dark band at cord of wing narrow but nearly complete, being interrupted just behind vein Cu_1; basal band variously broken. Male hypopygium (Fig. 52, L). ♂. L. 4.5-5 mm.; w. 5-5.5 mm. ♀. L. 5-5.5 mm.; w. 5.5-6 mm.

(June-Aug.) Ont., Que., N. S., Me., N. H., Vt., N. Y., westw. to Mich. and Kan., southw. to Md., Va. and N. C.

Connecticut.—Reported by C. W. Johnson, June 19 to Aug. 9, with no further data.

E. (*Ilisia*) **graphica** O. S.

1859\. *Erioptera graphica* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 227.

Fig.—Alexander, Cfls. N. Y., 1, pl. 35, fig. 82 (wing); 1919.

Generally similar to *armillaris* but ground-color of body and wings darker. Legs, especially the femora, more extensively blackened. Wings with dark band at cord, narrow, incomplete, not including the distal section of vein Cu_1. ♂. L. 4.5-5 mm.; w. 4.5-5 mm.

(June-Sept.) Ont., Mass., N. Y., westw. to Ia. and Neb., southw. to S. C., Ga., n. Fla. and La.

E. (*Ilisia*) **indianensis** Alex.

1922\. *Erioptera* (*Acyphona*) *indianensis* Alexander; Occas. Pap. Mus. Zool. Univ. Mich., 127: 1-2.

Mesonotal praescutum obscure yellow, with four brown stripes; pleura silvery gray, delimited by narrow, dark brown, longitudinal stripes. Gonapophyses appearing as strongly curved smooth hooks. ♂. L. 4-5 mm.; w. 4.5-5.5 mm.

(June) Ind., Ill., Ky., Mich., Ia. and Mo.

E. (*Ilisia*) **laevis** Alex. (Fig. 50, H).

1930\. *Erioptera* (*Ilisia*) *laevis* Alexander; Bull. Brooklyn Ent. Soc., 25: 77.

♂. L. 4.2-4.5 mm.; w. 5-5.5 mm.

(July, Aug.) Mass., Pa.

E. (*Ilisia*) **venusta** O. S.
1859. *Erioptera venusta* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 227.

Figs.—Osten Sacken, *Ibid.*, pl. 4, fig. 23; 1859. Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 17 (wing), pl. 4, fig. 16 (hyp.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 23, fig. 4 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 35, fig. 80 (wing); 1919. Dickinson, Cfls. Wisc., p. 193, fig. 77 (wing); 1932.

General coloration of thorax dark brown, the praescutum conspicuously paler, brownish yellow. Fore femora with two narrow brown rings, the remaining femora with a single subterminal annulus; tibiae entirely yellow. ♂. L. 4.5-5 mm.; w. 5-5.5 mm. ♀. L. 5-6 mm.; w. 5.5-6.5 mm.

(June-Sept.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Mich., Wisc., Ia. and Mo., southw. to Va. and Fla.

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.); Riverton, July 23, 1931 (C. P. A.); Salisbury, July 16, 1926 (W. E. B.), Sept. 5, 1928 (G. C. C.); Sept. 12, 1928 (C. P. A.); Sharon, Sept. 5, 1928 (G. C. C.); Twin Lakes, Sept. 12, 1928 (G. C. C.).

Cryptolabis Osten Sacken

1859. *Cryptolabis* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 224.

The members of this genus are chiefly Australian and Neotropical, a single species, the genotype, being found in northeastern North America. The adults are commonly swept from herbage on the banks of streams and it is strongly suspected that the immature stages are entirely aquatic.

Cryptolabis paradoxa O. S. (Fig. 50, I).
1859. *Cryptolabis paradoxa* Osten Sacken; *Ibid.*, 1859: 225.

Figs.—Osten Sacken, *Ibid.*, pl. 4, figs. 14, 15, 15a (wing, hyp.); 1859. Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 2, fig. 11 (wing), pl. 3, fig. 13 (gen.); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 30, fig. 1 (ven.); 1908. Williston, Man. N. Amer. Dipt., Ed. 3, fig. 25, sub 6 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 37, fig. 101 (ven.); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 8 (thorax); 1925.

General coloration of thorax blackish, the dorsopleural membrane pale yellow. Halteres yellow, the apex of stem darkened. Wings grayish, the prearcular region abruptly whitened; faint dusky cloudings along cord, *Cu* and in axillary region; *Rs* weakly convex; numerous macrotrichia in cells beyond cord. Genitalia of both sexes small and inconspicuous, more or less retracted within abdomen. ♂. L. 3-4 mm.; w. 4.5-6.5 mm. ♀. L. 4-4.5 mm.; w. 5.5-6.5 mm.

(July, Aug.) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., southw. to Va., Tenn., N. C., S. C. and Fla.

Connecticut.—Kent Falls, July 23-24, 1931 (C. P. A.)

Ormosia Rondani

1856. *Ormosia* Rondani; Prodrom. Dipt. Italicae, 1:180.
1860. *Rhypholophus* Kolenati; Wien. Ent. Monatschr., 4:393.

A very extensive group of essentially Holarctic crane-flies. European students tend to separate *Ormosia* from *Rhypholophus*, chiefly on the course of the *2nd* Anal vein, but in the local fauna no such division seems feasible. The adult flies occur in small dancing swarms in shaded places, while the early stages live in saturated earth near water.

The chief characters available for separation of many closely allied forms are found in the structure of the male hypopygium (Figs. 53, 54). It should be emphasized that in this group, as well as many others, the entire ninth segment of the abdomen of the male has undergone a torsion of approximately 180° so the tergal plate lies on the sternal surface of the body. This plate, in many species, appears as a conspicuous spatula jutting caudad between and apparently beneath the basistyles. In *manicata* it is profoundly incised so as to appear as a sheath on either side. The true relative positions of the various parts can readily be ascertained after detecting the tergite. The outer dististyle is variously formed, and in slide mounts sometimes lies mesad of the true inner style. The outer style is destitute of setae or punctures, whereas the inner style has a number of small punctures and often possesses a pale membrane in the axil of curvature or on the concave face.

Key to Species

(Based in part on male characters)

1. Wings with cell *1st* M_2 closed (Fig. 50, J) 2
   Wings with cell *1st* M_2 open 10
2. Wings spotted or clouded with darker 3
   Wings unicolorous or nearly so, only the stigmal area being darker 5
3. Anal veins divergent; wing-markings produced by dark brown spots and blotches on membrane 4
   Anal veins convergent, vein *2nd A* before tip bent strongly toward *1st A*; dark markings produced by groups of dark-colored trichia or very pale gray clouds on membrane (Fig. 50, J) .... **nubila**
4. Wings with brown dots in all cells, additional to a series of larger costal areas, the latter beyond stigma alternating with pale spots .... **innocens**
   Wings with three brown costal spots, the cord narrowly seamed with brown; apex of wing in outer radial field solidly darkened .... **apicalis**
5. Anal veins more or less convergent, *2nd A* being deflected cephalad on its distal third or more 6
   Anal veins divergent (*nigripila* group) 8
6. Wings broad (in ♀, 7.6x2.8 mm.); vein R_2 before origin of vein R_3; vague indications of darker seams along cord and vein *Cu* .... **cramptoniana**
   Wings relatively narrow (width not exceeding 2 mm.); vein R_2 distad of origin of R_3; no distinct seams on cord or vein *Cu*. (Compare also abnormal specimens of *holotricha*, having cell *1st* M_2 closed; see couplet 11) 7
7. Cell *1st* M_2 relatively large, subequal in length to, or only a little shorter than, the distal section of vein M_4; *m-cu* shortly beyond fork of *M*; wing-trichia relatively sparse; male hypopygium with the two dististyles unequal in size, the outer very small, subconical in outline (Fig. 53, B) **arcuata**
   Cell *1st* M_2 small, about one-half the length of the distal section of vein M_4; *m-cu* at fork of *M*; wing-trichia unusually abundant and well-dis-

tributed over disk; male hypopygium with two well-developed, long and slender dististyles, the outer a little longer than the inner .... **hubbelli**

8. Thorax and coxae reddish yellow .... **luteola**
Thorax reddish brown to gray, in the former case the praescutum with a median brown vitta 9
9. Mesonotal praescutum reddish, with a median brown line that is sometimes indistinct; antennae either pale throughout or with only the outermost segments darkened; gonapophyses of hypopygium bifid near apex .. **pygmaea**
Mesonotal praescutum brownish gray; antennae dark brown to black, the basal four segments pale; gonapophyses of hypopygium slender, simple (Fig. 54, E) .... **nigripila**
10. Wings with cell *1st* M_2 open by atrophy of *m*, the cell thus opening into cell *2nd* M_2 11
Wings with cell *1st* M_2 open by atrophy of basal section of vein M_3, the cell opening into cell M_3 13
11. Vein *2nd A* sinuous, at tip bent strongly toward *1st A*, narrowing the cell **holotricha**
Anal veins divergent (*nigripila* group) 12
12. Antennae dark brown throughout; mesonotal praescutum yellowish brown, with three dark brown stripes; scutellum brownish yellow; wings strongly tinged with brown, the veins conspicuous; cell M_3 short, only a little longer than its petiole .... **gaspensis**
Antennae with the basal four or five segments pale, the remainder brown; mesonotal praescutum grayish brown, with a median, darker brown vitta; scutellum grayish brown; wings hyaline, the stigmal region slightly darker, the veins inconspicuous; cell M_3 elongate, approximately twice its petiole **palpalis**
13. Antennae of both sexes relatively short, not exceeding the combined head and thorax (compare *dentifera*, *fernaldi*) 14
Antennae (♂) approximately as long as the entire body, or a little shorter (*mesocera*), extending at least to midlength of the abdomen; flagellar segments more or less narrowed apically, giving a bead-like appearance to the organ 29
14. Vein *2nd A* arcuated, at its tip bent toward *1st A*; in a few species only the extreme tip of *2nd A* is so deflected 15
Anal veins gradually divergent 24
15. Coloration of body gray; stigma conspicuously dark brown, preceded and followed by more whitish areas (*meigenii* group) 16
Coloration of body reddish or brown; if gray (*fernaldi*), the stigmal region is not conspicuously darkened 20
16. Male hypopygium with both pairs of gonapophyses conspicuously serrate on outer and apical margins (Fig. 53, D; 54, I) 17
Male hypopygium with the gonapophyses only weakly if at all serrate, in the latter case only a single pair so toothed (Figs. 53, G, I; 54, B) 18
17. Hypopygium with the outer dististyle bispinous (Fig. 53, D) .... **carolinensis**
Hypopygium with the outer dististyle bearing a single spine (Fig. 54, I) **serridens**
18. Hypopygium with the gonapophyses notably unequal in length, the outer or longer pair not dilated at base (Fig. 54, B) .... **meigenii**
Hypopygium with the gonapophyses approximately equal in length, where more unequal (*ithacana*), the longest pair strongly dilated at base (Fig. 53, G, I) 19
19. Gonapophyses appearing as relatively short blackened spikes (Fig. 53, G) **frisoni**
Gonapophyses more elongate, the basal pair weakly serrate before tips; outer apophyses strongly dilated at bases, pale except for the strongly divergent, blackened tips; outer dististyle usually bispinous, the spines directed in opposite directions toward one another (Fig. 53, I) .... **ithacana**
20. Only a single dististyle is well-developed, the outer being reduced to a small or very small, obtusely rounded lobule (Fig. 53, F, H) 21
Both dististyles well-developed, subequal in length (Fig. 54, H, J) 23
21. General coloration gray; antennae (♂) relatively long, extending about to

base of abdomen; hypopygium with inner dististyle shaped more or less like a boomerang, about three times the length of the outer; gonapophyses hairy (Fig. 53, F) .... **fernaldi**

General coloration brown to reddish brown; antennae short in both sexes; hypopygium with inner dististyle a slender, sclerotized hook, the outer style so reduced in size as to be virtually lacking; gonapophyses glabrous (Figs. 53, H; 54, F) 22

22. Inner dististyle narrowed to an acute black spinous point; aedeagus trifid at tip (Fig. 54, F) .... **nimbipennis**

Inner dististyle not narrowed into a spine, the obtuse apex bearing a long curved seta; aedeagus simple at tip (Fig. 53, H) .... **ingloria**

23. Mesonotal praescutum reddish brown, with a capillary dark brown median line; male hypopygium with both dististyles and each gonapophysis bearing a small lateral spine, so as to appear bifid (Fig. 54, H) .... **rubella**

Mesonotal praescutum reddish brown, unmarked with darker; male hypopygium with both dististyles and the gonapophyses unbranched (Fig. 54, J) **townesi**

24. Hypopygium with the tergal sheath profoundly divided by a median split; longest gonapophyses appearing as exceedingly lengthened, needle-like rods that jut from the genital chamber .... **manicata**

Hypopygium with the tergite a simple spatulate plate; gonapophyses not appearing as needle-like rods 25

25. Inner dististyle on outer margin before apex with a small, erect, pale lobule; aedeagus elongate (Fig. 53, A) 26

Inner dististyle not so armed; aedeagus short 27

26. Inner dististyle with the lateral lobe very small; aedeagus blackened, relatively short and stout, some distance before apex with two subtending black spines; apex of aedeagus microscopically roughened .... **brevicalcarata**

Inner dististyle with the lateral lobe elongate; aedeagus very long and slender, jutting some distance beyond the genital chamber, pale brown in color, not roughened near apex (Fig. 53, A) .... **adirondacensis**

27. Outer dististyle a short, squat, blackened structure, bearing three or four acute, black spines; inner style bidentate at apex, its acute lateral spine with microscopic denticulations at base (Fig. 54, G) .... **notmani**

Outer dististyle not as above, either simple or at most bispinous; inner style simple 28

28. Coloration of body brown, slightly overcast with gray; antennae short in both sexes; outer dististyle bispinous; gonapophyses appearing as slender erect rods (Fig. 53, C) .... **bilineata**

Coloration of body light gray; antennae (♂) relatively long, if bent backward extending to or shortly beyond root of halteres; both dististyles appearing as small, ear-like, simple lobes, the outer darkened, glabrous; gonapophyses appearing as powerful blackened horns, each bearing an acute tooth or spine on the inner or concave face (Fig. 53, E) .... **dentifera**

29. Anal veins strongly divergent; outer dististyle of hypopygium a curved blackened hook (Fig. 54, A) .... **megacera**

Anal veins slightly convergent (Fig. 23, E); outer dististyle a small flattened lobe, clothed with transverse rows of blackened setae (Fig. 54, C, D) 30

30. Antennae (♂) about equal in length to entire body, the flagellar segments elongated, black, attenuated and pale at apices; gonapophyses heavily blackened, bifid (Fig. 54, D) .... **monticola**

Antennae (♂) shorter, if bent backward extending about to midlength of the abdomen, the flagellar segments shorter, without pale tips; gonapophyses pale, simple, terminating in an acute point that is directed laterad (Fig. 54, C) .... **mesocera**

The groups in the above key that include more than a single species are as follows:

adirondacensis group.—*adirondacensis, brevicalcarata.*
bilineata group.—*bilineata, notmani.*
meigenii group.—*carolinensis, frisoni, ithacana, meigenii, serridens.*
nigripila group.—*gaspensis, luteola, nigripila, palpalis, pygmaea.*

nimbipennis group—*ingloria, nimbipennis, townesi.*
nubila group.—*apicalis, cramptoniana, innocens, nubila.*

The following names are omitted from the key, either because they are synonyms, or else are doubtful forms unknown to the present writer.

abnormis Dietz=*Oxydiscus cayuga* (Alex.)
atriceps Dietz=*apicalis* Alex.
divergens Dietz=*megacera* Alex.
parallela Doane=Identity doubtful.
perplexa Dietz=Identity doubtful.
pilosa Dietz=*pygmaea* Alex.
subcostata Dietz=Identity doubtful.

Brief diagnoses of the doubtful species are included in order to complete the report.

Ormosia aenigmatica Dietz (Trans. Amer. Ent. Soc., 47:249; 1921), described as a variety of *rubella.* It was described as having a beak nearly as long as the thorax. An examination of the type specimen by Professor Rogers has disclosed the fact that the supposed "beak" is merely an artifact and the subspecies name should be placed in the synonymy of *rubella.*

Ormosia parallela (Doane) (Ent. News, 19:202; 1908, as *Rhypholophus*). Thorax reddish yellow, slightly darker above. Antennae entirely pale yellow. Halteres yellow, the knobs at tips slightly infuscated. Abdominal tergites brownish, sternites yellow. Wings rather narrow, brownish, without distinct stigma; cell *1st* M_2 open by atrophy of basal section of M_3; Anal veins convergent. ♀. L. 5 mm.; w. 6 mm. Ithaca, N. Y.; known only from female specimens.

Ormosia perplexa Dietz (Trans. Amer. Ent. Soc., 42:141; 1916). Thorax fuscous, with a grayish bloom, the praescutum with a median darker brown stripe. Knob of haltere yellowish white. Wings brownish, without evident stigma; cell *1st* M_2 open by atrophy of basal section of M_3; *m-cu* before fork of M; Anal veins convergent. ♀. L. 3.5 mm.; w. 3.75 mm. Waverly, N. Y.; a single female.

Ormosia subcostata Dietz (*Ibid.,* 47:249-250; 1921). Thorax grayish, with a more whitish pruinosity, the median area of praescutum with a sordid yellow median stripe that is bordered on either side by a narrow brown vitta. Antennae of moderate length, light brown. Pleura reddish brown. Halteres yellow. Wings yellowish gray, more yellowish at base; costal region appearing infuscated, due to an increased density of pubescence; stigmal region darker; cell *1st* M_2 open by atrophy of basal section of M_3; Anal veins convergent. Male hypopygium with the dististyles small, blackish. ♂. L. 4 mm.; w. 5.5 mm. Hazleton, Pa.; Aug. 15, 1911.

All of these species, with cell *1st* M_2 open by atrophy of M_3 and the Anal veins convergent, are evidently allied, in the present key running to couplet twenty and beyond.

Ormosia adirondacensis Alex. (Fig. 53, A).
1919. *Ormosia adirondacensis* Alexander: Insec. Inscit. Menst., 7: 145-146.

General coloration of mesonotum reddish brown, very sparsely pruinose, the postnotum and dorsal pleurites darker. Halteres pale throughout. Antennae (♂) moderately long, if bent backward extending to beyond the wing-root; flagellar segments with a dense white pubescence. Male hypopygium (Fig. 53, A). ♂. L. about 4-5 mm.; w. 4.5-5.8 mm. ♀. L. about 5-5.5 mm.; w. 5-5.5 mm.

(June) Me., N. H., Vt., Mass., N. Y., southw. to Tenn.

Connecticut.—Union, June 14, 1933 (C. P. A.); Westford, June 14, 1933 (C. P. A.).

I have interpreted the Anal veins as being divergent although vein *2nd A* on distal quarter is deflected slightly cephalad.

O. apicalis Alex.

1911. *Ormosia apicalis* Alexander; Psyche, 18: 200-201.
1916. *Ormosia atriceps* Dietz; Trans. Amer. Ent. Soc., 42: 136-137.

Figs.—Alexander, *Ibid.*, pl. 16, fig. 6 (wing); 1911. Dietz, *Ibid.*, pl. 10, figs. 1-2 (hyp., diagramm.); 1916. Alexander, Cfls. N. Y., 1, pl. 34, fig. 55 (wing); 1919.

Mesonotum reddish brown, the pleura darker. Head obscure blackish. Antennae short. Knobs of halteres weakly infumed. Male hypopygium with a single dististyle, oval, on mesal face set with triangular blackened points to appear mace-like. ♂. L. 5-5.5 mm.; w. 5.5-7 mm. ♀. L. 6.5-7.5 mm.; w. 8-8.5 mm.

(June, July) N. Y., N. J., Pa., southw. to S. C. and Ga. (in mts.).

O. arcuata (Doane) (Fig. 53, B).

1908. *Rhypholophus arcuatus* Doane; Ent. News, 19: 201.

Fig.—Dickinson, Cfls. Wisc., p. 189, fig. 69 (wing); 1932.

General coloration gray; pseudosutural foveae and tuberculate pits black. Antennae dark brown throughout. Knobs of halteres weakly infumed. Legs light brown. Wings with *m-cu* shortly beyond fork of *M*. Male hypopygium (Fig. 53, B). ♂. L. 4.5-5 mm.; w. 5-6 mm. ♀. L. 5-6 mm.; w. 6.5-7 mm.

(Apr.-June; Aug., Sept.) Ont., Que., N. B., Me., N. H., Mass., N. Y., Pa., westw. to Wisc. and Alta., southw. to Tenn.

O. bilineata Dietz (Fig. 53, C).

1916. *Ormosia bilineata* Dietz; Trans. Amer. Ent. Soc., 42: 142-143.
1929. *O. huronis* Alexander; Can. Ent., 61: 20-21.

Figs.—Dietz, *Ibid.*, pl. 10, fig. 8 (hyp., diagramm.); 1916. Alexander, Can. Ent., 61: 21, fig. 2 (hyp.); 1929.

General coloration pale brownish gray. Antennae dark brown throughout, relatively long (♂), if bent backward extending nearly to wing-root. Halteres pale yellow. Male hypopygium (Fig. 53, C). The two blackish lines on praescutum indicated by the name are poorly defined or lacking. ♂. L. 4-5 mm.; w. 4-5.5 mm. ♀. L. 4.5-5.5 mm.; w. 5-5.5 mm.

(Late Apr.-June) Que., N. B., N. H., Mass., N. Y., westw. to Mich. and S. D. (Black Hills), southw. to N. C. (Great Smokies).

Connecticut.—Riverton, May 16, 1931 (C. P. A.).

O. brevicalcarata Alex.

1927. *Ormosia brevicalcarata* Alexander; Journ. N. Y. Ent. Soc., 35: 61-62.

Allied to *adirondacensis*. Mesonotum reddish brown, the praescutum with a darker median line. Wings subhyaline, the stigmal region darker; vein *2nd A* very slightly sinuous, the distal third converging very slightly toward *1st A*. ♂. L. about 3.5-4 mm.; w. 3.3-4.5 mm. ♀. L. 4-4.5 mm.; w. 4.3-4.8 mm.

(June, July) Pa., N. C., S. C., Tenn., southw. to nw. Fla.

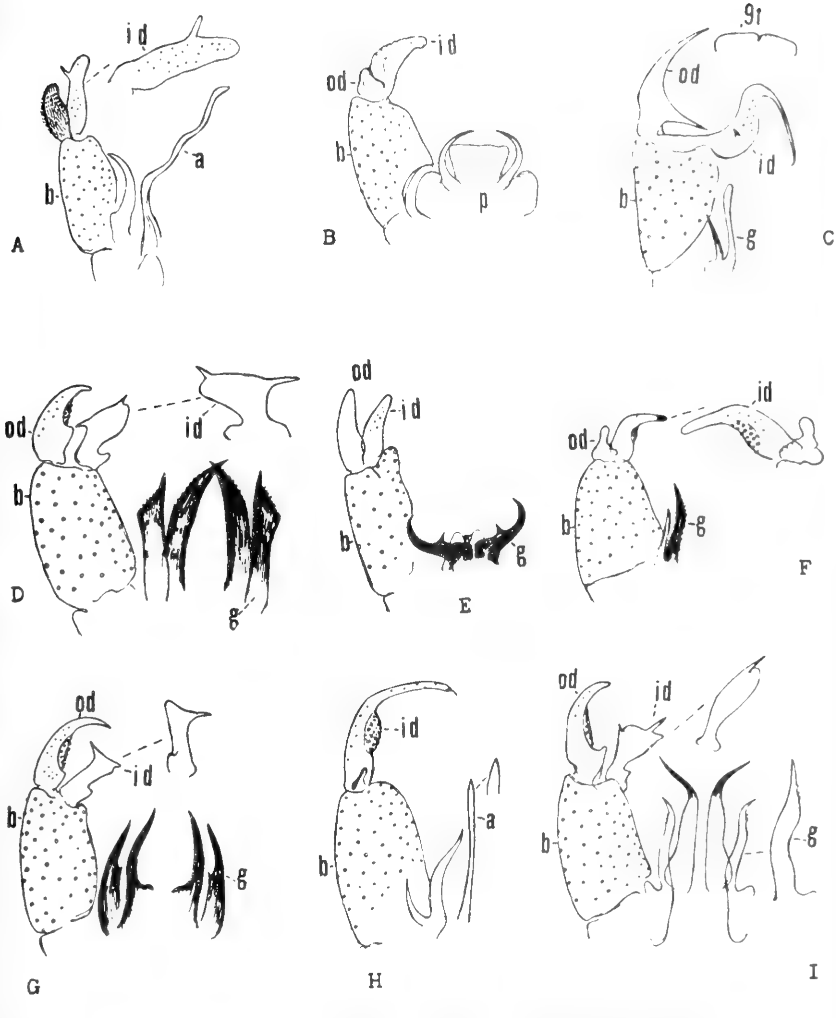


FIGURE 53. Eriopterini: *Ormosia*; male hypopygia.

A. *Ormosia adirondacensis* Alex.
B. *O. arcuata* (Doane)
C. *O. bilineata* Dtz.
D. *O. carolinensis* Alex.
E. *O. dentifera* Alex.
F. *O. fernaldi* Alex.
G. *O. frisoni* Alex.
H. *O. ingloria* Alex.
I. *O. ithacana* Alex.

Symbols: *a*, aedeagus; *b*, basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *t*, tergite.

O. carolinensis Alex. (Fig. 53, D).
1925. *Ormosia carolinensis* Alexander; Ent. News, 36:229.

Belongs to the *meigenii* group: most closely allied to *serridens*, differing chiefly in hypopygial characters (Fig. 53, D). ♂. L. about 2.6-2.8 mm.; w. 4.2-4.4 mm.

(March) N. C., S. C.

It is possible that this fly represents only a race of *serridens*.

O. cramptoniana Alex.
1929. *Ormosia cramptoniana* Alexander; Can. Ent., 61:249.

Allied to *nubila*. General coloration dark gray. Antennae dark brown throughout. Wings with cell *1st* M_2 relatively small; *m-cu* shortly before fork of *M*. ♂. L. about 6 mm.; w. 6-6.5 mm. ♀. L. about 7.5 mm.; w. 7.6 x 2.8 mm.

(Late June, early July) Que. (Gaspé).

O. dentifera Alex. (Fig. 53, E).
1919. *Ormosia dentifera* Alexander; Insec. Inscit. Menst., 7:144-145.

General coloration clear gray. Antennae (♂) black throughout; flagellar segments fusiform, with outspreading setae. Halteres pale. Wings with stigma not or but slightly indicated. Hypopygium bright yellow (Fig. 53, E). ♂. L. 3-3.8 mm.; w. 3.5-4.3 mm. ♀. L. 3.8-4 mm.; w. 4.5-4.6 mm.

(May-mid-June) Que., N. B., Me., N. H., Vt., Mass., Ct., N. Y.

Connecticut.—Riverton, May 16, 1931 (C. P. A.).

O. fernaldi Alex. (Fig. 53, F).
1924. *Ormosia fernaldi* Alexander; Occas. Pap. Boston Soc. Nat. Hist., 5:116-117.

General coloration brownish gray, the pleura clear gray. Knobs of halteres yellowish. Wings tinged with gray, the stigma vaguely more infuscated; Anal veins converging at outer ends. Male hypopygium (Fig. 53, F). ♂. L. about 3.2 mm.; w. 4 mm. ♀. L. 3.5 mm.; w. 4-4.5 mm.

(May) Mass.

O. frisoni Alex. (Fig. 53, G).
1920. *Ormosia frisoni* Alexander; Can. Ent., 52:224-225.

Belongs to the *meigenii* group; closest to *meigenii*, from which it is most readily told by the structure of the male hypopygium (Fig. 53, G). ♂. L. 3-3.5 mm.; w. 4-4.5 mm. ♀. L. 3.8-4 mm.; w. 4-4.8 mm.

(May) Ind., Ill., Mich., Ia.

O. gaspensis Alex.
1929. *Ormosia gaspensis* Alexander; Can. Ent., 61:249-250.

Belongs to the *nigripila* group. Male hypopygium with the inner dististyle unusually short and stout, the expanded apex more or less bilobed. ♂. L. about 3-3.2 mm.; w. 4-4.2 mm. ♀. L. about 3.5 mm.; w. 4-4.4 mm.

(June) Que., N. B.

O. holotricha (O. S.)
1859. *Erioptera holotricha* Osten Sacken; Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.
1869. *Rhypholophus holotrichus* Osten Sacken; Mon. Dipt. N. Amer., 4: 143-144.

General coloration pale gray to yellowish gray, the praescutum scarcely striped. Antennae entirely brownish black. Halteres yellow. Wings pale yellowish brown, the stigma barely darker. Male hypopygium with the outer dististyle a small acute black spine from a pale conical base; inner dististyle much longer, appearing as an angulated or sinuous rod, blackened and sparsely setiferous on outer half. ♂. L. about 4.5-5 mm.; w. 4-4.5 mm. ♀. L. about 5-5.5 mm.; w. about 5.5-5.8 mm.

(Late Apr., May) N. H., Vt., Mass., N. Y., southw. to N. C. and Tenn.

O. hubbelli Alex.
1926. *Ormosia hubbelli* Alexander; Insec. Inscit. Menst., 14: 20-21.

Belongs to the *bivittata* group. General coloration brown, the praescutum with two dark brown longitudinal stripes. Halteres with dark brown knobs. Wings strongly tinged with brown, the stigma scarcely darker. Male hypopygium with the outer dististyle a trifle longer than inner, blackened and microscopically serrulate along outer margin. ♂. L. about 5 mm.; w. 5 mm.

(Aug.) Man., Minn., N. Dak.

O. ingloria Alex. (Fig. 53, H).
1929. *Ormosia ingloria* Alexander; Can. Ent., 61: 21-22.

Fig.—Alexander, *Ibid.*, 61: 21, fig. 3 (hyp.); 1929.

Closely allied to *nimbipennis*, differing especially in the structure of the male hypopygium (Fig. 53, H). ♂. L. about 4 mm.; w. 4.8-5 mm. ♀. L. about 4.8 mm.; w. 5.2 mm.

(Aug.) Ont., Ind.

O. innocens (O. S.)
1869. *Rhypholophus innocens* Osten Sacken; Mon. Dipt. N. Amer., 4:142.

Figs.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 56 (wing); 1919. Crampton, Trans. Amer. Ent. Soc., 48, pl. 10, fig. 38 (hyp.); 1923.

General coloration gray. Antennae black throughout. Knobs of halteres weakly darkened. Male hypopygium with the mesal face of dististyle set with a few large marginal teeth. ♂. L. 4.5-5 mm.; w. 5-6 mm. ♀. L. 5-5.5 mm.; w. 5.5-6.5 mm.

(Apr.-mid-June) N. H., Vt., Mass., N. Y., N. J., westw. to Ohio, Ind. and Mich., southw. to Va., Tenn., N. C. and S. C.

Connecticut.—Norfolk, May 16, 1931 (C. P. A.).

O. ithacana Alex. (Fig. 53, I).
1929. *Ormosia ithacana* Alexander; Bull. Brooklyn Ent. Soc., 24:29.

Belongs to the *meigenii* group; closest to *meigenii*, differing especially in the structure of the male hypopygium (Fig. 53, I). ♂. L. 3.8-4.2 mm.; w. 5-5.5 mm.

(Late Apr.-early May) N. Y.

O. luteola Dietz
1916. *Ormosia luteola* Dietz; Trans. Amer. Ent. Soc., 42:138-139.

Fig.—Dietz, *Ibid.*, pl. 10, fig. 4 (hyp., diagramm.); 1916.

Belongs to the *nigripila* group. Thorax, including coxae, yellow to reddish yellow. Antennae generally pale, the outer segments darker. Wings broad, with a grayish brown tinge, the stigmal region darker. ♂. L. 4-5.5 mm.; w. 4.5-6 mm. ♀. L. 6-6.5 mm.; w. 6-7 mm.

(June-Sept.) Me., N. H., Vt., Mass., Ct., N. Y., Pa., westw. to Mich.

Connecticut.—East River, June 19, 1911 (Ely); Tunxis State Park, July 23-24, 1931 (C. P. A.).

O. manicata (Doane)
1900. *Rhypholophus manicatus* Doane; Journ. N. Y. Ent. Soc., 8:187.
1916. *Ormosia deviata* Dietz; Trans. Amer. Ent. Soc., 42:143-144.

Figs.—Dietz, *Ibid.*, pl. 10, figs. 9, 9A (hyp., diagramm.); 1916. Alexander, Cfls. N. Y., 1, pl. 34, fig. 60 (wing); 1919 (as *rubella*).

General coloration reddish brown, the praescutum more grayish brown medially. Antennae relatively short, with long conspicuous verticils. Halteres with weakly darkened knobs. Wings with a grayish tinge, the stigma pale brown.

Readily told from all other regional species by the profoundly divided ninth tergite and the needle-like gonapophyses. Allied species occur in western North America and in Japan. ♂. L. 4-4.5 mm.; w. 5-5.5 mm. ♀. L. 5 mm.; w. 5-5.5 mm.

(May, June; Aug.-Oct.) Ont., Que., N. B., N. S., Me., N. H., Vt., Mass., N. Y., Pa., westw. to the Pacific States.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Kent Falls, May 30-31, June 12-13, 1931 (C. P. A.); Putnam, June 15, 1933 (C. P. A.) (in bog); Riverton, May 30, June 12, 1931 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.).

O. megacera Alex. (Fig. 54, A).
1916. *Ormosia divergens* Dietz; Trans. Amer. Ent. Soc., 42:144-145 (nec *divergens* Coquillet, 1905).
1917. *Ormosia megacera* Alexander; Can. Ent., 49:26.

Figs.—Dietz, *Ibid.*, pl. 10, fig. 10 (hyp., diagramm.); 1916. Alexander, Cfls. N. Y., 1, pl. 34, fig. 64 (wing); 1919.

General coloration dark brown, praescutum with three still darker brown stripes. Antennae dark brown, approximately as long as body (♂). Halteres dark brown, paler basally. Wings with a faint gray tinge; stigma ill-defined. Male hypopygium (Fig. 54, A). ♂. L. 3-4.5 mm.; w. 4.5-5.5 mm.

(June; Sept.) Que., N. B., Me., N. H., Vt., N. Y., Pa.

O. meigenii (O. S.) (Fig. 54, B).
1859. *Erioptera meigenii* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 226.
1869. *Rhypholophus meigenii* Osten Sacken: Mon. Dipt. N. Amer., 4: 144-145.

Fig.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 61 (wing); 1919.

General coloration gray. Halteres light yellow. Wings with a gray tinge, the stigma brown, well-marked, preceded and followed by somewhat more whitish areas; cell *2nd* M_2 nearly truncate at base. Male hypopygium (Fig. 54, B). ♂. L. 3.6-4.5 mm.; w. 4.5-5.8 mm. ♀. L. 4.5-5 mm.; w. 5-5.5 mm.

(May, early June) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ohio and Ill., southw. to Va. and S. C.

Connecticut.—Kent Falls, May 17, 30, 31, 1931 (C. P. A.); Norfolk, May 16, 1931 (C. P. A.); Riverton, May 16, 30, 1931 (C. P. A.); Tyler Lake, June 13, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.); Winsted, May 16, 1931 (C. P. A.).

O. mesocera Alex. (Fig. 54, C).
1917. *Ormosia mesocera* Alexander: Can. Ent., 49: 25.

Fig.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 63 (wing); 1919.

General coloration light to dark brown, heavily gray pruinose; anterior lateral pretergites yellow. Antennae (♂) black throughout, if bent backward extending about to midlength of abdomen. Halteres pale. Wings with a strong grayish tinge, the stigmal region slightly darker. Male hypopygium (Fig. 54, C). ♂. L. 3.7-4.5 mm.; w. 3.8-5.5 mm. ♀. L. about 4-4.2 mm.; w. 4.5-5 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., N. Y.

O. monticola (O. S.) (Figs. 23, E; 54, D).
1869. *Rhypholophus monticola* Osten Sacken: Mon. Dipt. N. Amer., 4: 145-146.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 22, fig. 5 (ven.); 1908, (vein *2nd A* erroneous). Alexander, Cfls. N. Y., 1, pl. 34, fig. 62 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 7 (thorax); 1925.

General coloration pale brown, the praescutum with a somewhat darker median stripe and sometimes with a bluish gray pruinosity; pleura yellow. Knobs of halteres weakly darkened. Legs pale brown, the tarsi paling to light yellow or yellowish-white. Male hypopygium

(Fig. 54, D). ♂. L. 3.5-5 mm.; w. 4-6 mm. ♀. L. 5-5.5 mm.; w. 5.5-6 mm.

(Aug.-mid-Sept.) Que., Ont., N. B., Me., N. H., Vt., Mass., Ct., N. Y., Pa., westw. to Mich., southw. to N. C.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); E. Hartland, Sept. 11, 1928 (C. P. A.); East River, Sept. 1910 (Ely); Kent Falls, Aug. 19, 1931 (C. P. A.); Norfolk, Sept. 6, 1928 (G. C. C.); Salisbury, Sept. 5, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.); Winsted, Sept. 5, 1928 (G. C. C.).

O. nigripila (O. S.) (Fig. 54, E).
1869. *Rhypholophus nigripilus* Osten Sacken; Mon. Dipt. N. Amer., 4: 142-143.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 22, fig. 4 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 34, fig. 57 (wing); 1919.

General coloration dark brown, gray pruinose. Male hypopygium (Fig. 54, E): gonapophyses appearing as slender simple rods, curved to the acute tips. ♂. L. 3.5-4 mm.; w. 4-5 mm. ♀. L. about 4.5-5 mm.; w. 5 mm.

(May, June; Sept.) Ct., Pa., D. C., Va., westw. to Ind. and Mich., southw. to S. C. and Fla.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Middletown, May 31, 1929 (R. C. N.) (at light); Riverton, May 30, 1931 (C. P. A.).

O. nimbipennis Alex. (Fig. 54, F).
1917. *Ormosia nimbipennis* Alexander; Can. Ent., 49: 24-25.

Figs.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 59 (wing); 1919. Alexander, Can. Ent., 61: 21, fig. 4 (hyp.); 1929.

Mesonotal praescutum reddish brown to dark gray; remainder of thorax gray to dark grayish brown. Halteres pale yellow. Wings with a strong dusky tinge, the stigma still darker. Male hypopygium (Fig. 54, F) usually brighter than remainder of abdomen. ♂. L. 4-5 mm.; w. 4.5-6 mm. ♀. L. 5 mm.; w. 5-6 mm.

(July-Sept.) N. B., Me., N. H., Vt., Mass., Ct., N. Y., westw. to Mich.

Connecticut.—Cornwall Bridge, Aug. 19, 1931 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

O. notmani Alex. (Fig. 54, G).
1920. *Ormosia notmani* Alexander; Can. Ent., 52: 225.

General coloration gray. Antennae relatively short, black throughout. Knobs of halteres light yellow. Wings tinged with gray, the stigmal region more infumed; vein *2nd A* feebly sinuous near extreme tip but Anal veins decidedly divergent. Male hypopygium (Fig. 54, G). The peculiar structure of the outer dististyle is approached by *O. cornuta* (Doane) and *O. subcornuta* Alex., of western North America. ♂. L. 3.5-3.8 mm.; w. 4-4.5 mm. ♀. L. 4 mm.; w. 4 mm.

(May, June) Ont., Que., Mass., Ct., N. Y.

Connecticut.—Riverton, May 16, 1931 (C. P. A.).

O. nubila (O. S.) (Fig. 50, J).

1859. *Erioptera nubila* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 227.

1869. *Rhypholophus nubilus* Osten Sacken: Mon. Dipt. N. Amer., 4: 141-142.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 14 (wing); 1869. Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 22, fig. 3 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 34, fig. 54 (wing); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 3, fig. 13 (thorax); 1925.

General coloration gray, the praescutum with a single dark brown median stripe. Antennae brown, the basal segments paler. Halteres pale. Wings with cell *1st* M_2 frequently open by atrophy or partial atrophy of m; R_2 shortly before origin of vein R_3 (Fig. 50, J). Abdomen dark brown, the caudal margins of the segments restrictedly pale. ♂. L. 4.5-5 mm.; w. 5-5.8 mm. ♀. L. 5.5-6 mm.; w. 6.5-7 mm.

(Apr.-early June; Aug., Sept.) Me., N. H., Vt., Mass., N. Y., Pa., westw. to O. and Ill., southw. to Va., Tenn. and S. C.

Connecticut.—Granby, Sept. 4, 1928 (G. C. C.); Kent Falls, May 3, 1931 (C. P. A.); Riverton, May 16, 1931 (C. P. A.); Salisbury, May 16, 1931, Sept. 5, 1928 (C. P. A., G. C. C.); Tunxis State Forest, May 16, 1931 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

O. palpalis Dtz.

1916. *Ormosia palpalis* Dietz; Trans. Amer. Ent. Soc., 42: 140.

Fig.—Dietz, *Ibid.*, pl. 10, fig. 6 (hyp.).

Belongs to the *nigripila* group. General coloration grayish brown, the praescutum with a darker median line. Antennae brown, the basal four or five segments yellowish. Wings hyaline, the stigmal region slightly darker. ♂. L. 3.25 mm.; w. 4.25 mm.

(Sept., Oct.) Pa.

O. pygmaea (Alex.)

1912. *Trimicra pygmaea* Alexander: Psyche, 19: 166.

1916. *Ormosia pilosa* Dietz; Trans. Amer. Ent. Soc., 42: 139.

Figs.—Alexander, *Ibid.*, 19, pl. 13, fig. 3 (wing). Dietz, *Ibid.*, pl. 10, fig. 5 (hyp.). Alexander, Cfls. N. Y., 1, pl. 34, fig. 58 (wing); 1919.

Belongs to the *nigripila* group. Gonapophyses differing from those of *nigripila* by being relatively short and stout, broad, bearing an acute spine on outer margin just back of the similarly acute apex. ♂. L. 3.5-4 mm.; w. 4-5 mm. ♀. L. 4.5 mm.; w. 5 mm.

(May-early July; Aug., Sept.) Que., N. B., Me., N. H., Vt., Mass., Ct., N. Y., Pa., O., Mich.; southw. to N. C. (more northern than *nigripila*).

Connecticut.—E. Connecticut, May 24 (C. W. J.); Norfolk, June 9, 1929, Sept. 11, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

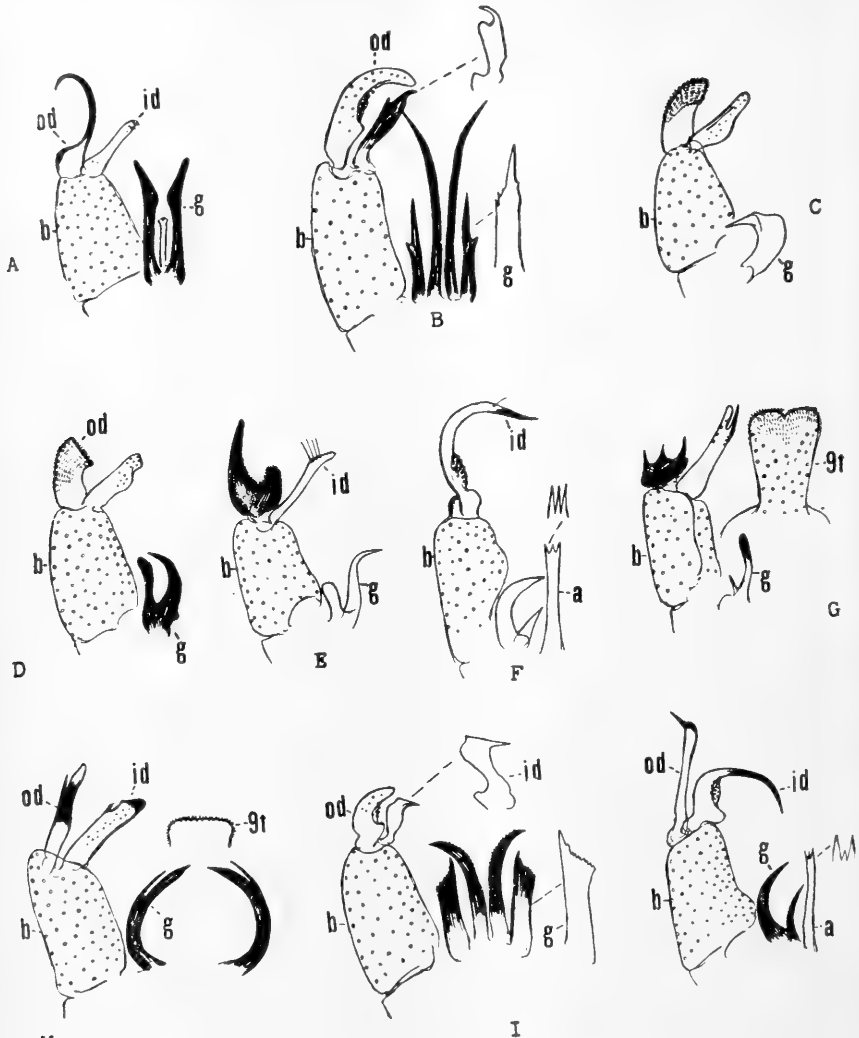


FIGURE 54. Eriopterini: *Ormosia;* male hypopygia.

A. *Ormosia megacera* Alex.
B. *O. meigenii* (O. S.)
C. *O. mesocera* Alex.
D. *O. monticola* (O. S.)
E. *O. nigripila* (O. S.)
F. *O. nimbipennis* Alex.
G. *O. notmani* Alex.
H. *O. rubella* (O. S.)
I. *O. serridens* Alex.
J. *O. townesi* Alex.

Symbols: *a*, aedeagus; *b*, basistyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *t*, tergite.

O. rubella (O. S.) (Fig. 54, H).
1869. *Rhypholophus rubellus* Osten Sacken: Mon. Dipt. N. Amer., 4: 144.
1921. *Ormosia rubella aenigmatica* Dietz: Trans. Amer. Ent. Soc., 47: 249.

Figs.—Osten Sacken, *Ibid.*, pl. 1, fig. 15 (wing). Williston, Man. N. Amer. Dipt., Ed. 3: 84, fig. 25, sub 11 (wing); 1908. Dickinson, Cfls. Wisc., p. 190, fig. 70 (wing); 1932.

Mesonotum chiefly light reddish brown; pleura somewhat more darkened. Halteres yellow. Terminal tarsal segments dusky. Male hypopygium (Fig. 54, H). ♂. L. 3.7-4 mm.; w. 4.2-4.5 mm. ♀. L. 5 mm.; w. 5.5 mm.

(Late Aug.-Oct.) Ont., Me., N. H., Vt., Mass., Ct., N. Y., Pa., westw. to Ind., Mich. and Wisc., southw. to Ga.

Connecticut.—Norfolk, Sept. 5, 1928 (G. C. C.), Sept. 11, 1928 (C. P. A.); Salisbury, Sept. 5, 1928 (G. C. C.), Sept. 12, 1928 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); W. Granby, Sept. 11, 1928 (C. P. A.).

O. serridens Alex. (Fig. 54, I).
1919. *Ormosia serridens* Alexander; Insec. Inscit. Menst., 7: 144.

Belongs to the *meigenii* group. Most readily told by the structure of the male hypopygium (Fig. 54, I). ♂. L. 3.8-4 mm.; w. 4.5-4.8 mm.

(Apr.) Md., Va.

O. townesi Alex. (Fig. 54, J).
1933. *Ormosia townesi* Alexander; Journ. N. Y. Ent. Soc., 41: 99-100.

Belongs to the *nimbipennis* group. Mesonotal praescutum reddish brown, contrasting conspicuously with the dark brown pleura and posterior sclerites of mesonotum. Halteres pale yellow. Male hypopygium (Fig. 54, J) with both dististyles elongate. ♂. L. 4.5 mm.; w. 5.8 mm. ♀. L. about 5 mm.; w. 6 mm.

(Late Aug.) N. C. (in mts.).

Tasiocera Skuse

1889. *Tasiocera* Skuse; Proc. Linn. Soc. N. S. W. (2) 4: 815.

Subgenus **Dasymolophilus** Goetghbuer

1920. *Molophilus* (*Dasymolophilus*) Goetghbuer; Bull. Soc. Ent. Belgique, 2: 132.

A small group of Holarctic crane-flies, now placed as a subgenus of the antipodal genus *Tasiocera* Skuse. The present group is well-distinguished from *Molophilus* by the presence of trichia in the cells of the wings; vein R_2 in transverse alignment with R_{2+3}, and by the male hypopygium having a single dististyle of simple structure. These crane-flies are the smallest species in the local fauna, the adults occur-

ring in dancing swarms near small streams. The immature stages are unknown.

Key to Species

1. Mesonotum pale reddish yellow, contrasting with the dark brown abdomen and halteres; wings with anal angle lacking, vein *2nd A* short; wings dimidiate, the base paler than apex .... **niphadias**

   Body, including mesonotum, dark brown; wings with anal angle slightly indicated, vein *2nd A* longer; wings uniformly infumed, with a pale longitudinal streak above vein *M* .... **ursina**

T. (*Dasymolophilus*) **niphadias** (Alex.) (Fig. 50, K).
1925. *Molophilus* (*Dasymolophilus*) *niphadias* Alexander: Ent. News, 36: 229-230.

Head brownish testaceous. Wings (Fig. 50, K) indistinctly dimidiate, the basal half whitish subhyaline, cells beyond cord distinctly infumed. ♂. L. 1.6 mm.; w. 2.2 mm.

(June) Ind., Mich., southw. to Tenn. and n. Fla.

T. (*Dasymolophilus*) **ursina** (O. S.) (Fig. 55, A).
1859. *Erioptera ursina* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 228.

Figs.—Alexander, Proc. Acad. Nat. Sci. Philadelphia, 1916, pl. 27, fig. 39 (ven.); 1916. Alexander, Cfls. N. Y., 1, pl. 34, fig. 70 (ven.); 1919.

General coloration dark brown to black; body conspicuously clothed with long black setae. Male hypopygium (Fig. 55, A). ♂. L. 1.8-2 mm.; w. 2.5-2.6 mm. ♀. L. 2 mm.; w. 2.5 mm.

(Late Apr.-July) Me., N. H., Vt., Mass., N. Y., Md., D. C., N. C. and Tenn.

Connecticut.—Kent Falls, June 12-13, July 23-24, 1931 (C. P. A.).

Molophilus Curtis

1833. *Molophilus* Curtis; Brit. Ent., p. 444.

A vast genus of small or medium-sized hairy flies. The adults may be swept from rank vegetation near water or be found in small dancing swarms in shaded spots. The immature stages occur in moist earth.

The local species fall in two groups, termed the *plagiatus* and *gracilis* groups, respectively, that are very numerous in species in Australia and New Zealand, with somewhat fewer members in South and Middle America. Their present distribution has evidently been attained by migrations across Antarctica and thence northward through the Americas.

Key to Species

(Based on male characters)

1. Male hypopygium with ventral lobe of basistyle produced near apex into a small sclerotized beak; both dististyles lying in notch of basistyle, widely separated by membrane; mesal lobe of basistyle not developed; outer dististyle deeply bifid (*plagiatus* group) (Fig. 55, C, F, I, M) 2

Male hypopygium with ventral lobe of basistyle unarmed; both dististyles simple, placed close together near apex of basistyle; mesal lobe of basistyle conspicuously developed and provided (except in *auricomus*) with a dozen or more black spines or spinous setae (*gracilis* group) (Fig. 55, B, D, E, G, H, J, K, L) 5

2. Antennae (♂) of moderate length, if bent backward extending about to root of halteres, the flagellar segments clothed with a long white pubescence.. 3
Antennae short in both sexes, ending opposite or before wing-root; male hypopygium (Fig. 55, F) with the basal dististyle bearing a simple acute spine on outer face at near one-third the length.................. **hirtipennis**

3. Male hypopygium with the basal dististyle a long straight unbranched rod (Fig. 55, I); size very small (wing, 3.5 mm. or less) ..... **nova-caesariensis**
Male hypopygium with the basal dististyle variously branched; (Fig. 55, C, M); size larger (wing, 4.5 mm. or more) 4

4. Male hypopygium with the basal dististyle terminating in four acute spines (Fig. 55, M) .... **quadrispinosus**
Male hypopygium with the axial stem of basal dististyle bearing a single long slender spine on inner face at near midlength (Fig. 55, C)........ **cramptoni**

5. Wings with distinct brown seams along vein *Cu* and over *m-cu*........... **soror**
Wings immaculate 6

6. Male hypopygium with mesal lobe of basistyle without blackened points, all setae being long and pale in color; dorsal lobe of basistyle very slender (Fig. 55, B); both dististyles appearing as long slender rods, acute at tips .... **auricomus**
Male hypopygium with mesal lobe of basistyle set with blackened spinous points or elongate spiniform setae; dorsal lobe of basistyle stout; both dististyles short and more or less curved (Fig. 55, D, E, G, H, J, K, L) 7

7. Antennae (♂) short, if bent backward not attaining the wing-root; male hypopygium (Fig. 55, D) .... **forcipulus**
Antennae (♂) elongate, if bent backward extending to base of abdomen or beyond 8

8. Antennae (♂) relatively short, approximately one-half the length of body, or extending about to base of abdomen 9
Antennae (♂) longer, if bent backward extending approximately to midlength of abdomen 10

9. Dorsal lobe of basistyle unusually long, extending caudad beyond level of apex of outer dististyle; vestiture of mesal lobe consisting of small black spines; outer dististyle conspicuously roughened, both on inner and outer margins; inner style with a few microscopic spinulae on concave margin before the long black apical point (Fig. 55, K); size small (w. ♂, about 3.5 mm.) .... **pollex**
Dorsal lobe of basistyle small, extending caudad only beyond bases of styli; festiture of mesal lobe consisting of elongate spines or long spinous setae; outer dististyle almost smooth, with relatively few microscopic points; inner style smooth (Fig. 55, H); size larger (w. ♂, about 5 mm.).. **laricicola**

10. Costal fringe (♀) light golden-yellow, of ♂ somewhat darker, light brown; male hypopygium with the outer dististyle glabrous, except for a few microscopic setulae on disk (Fig. 55, L) .... **pubipennis**
Costal fringe brown in both sexes; male hypopygium with the outer dististyle provided with abundant microscopic setulae on distal half or more (Fig. 55, E, G, J) 11

11. Male hypopygium with the outer dististyle relatively slender, the apical point elongate; spines or spinous setae of mesal lobe of basistyle long and conspicuous (Fig. 55, E) .... **fultonensis**
Male hypopygium with the outer dististyle wider; spines of mesal lobe of basistyle unusually short and peg-like (Fig. 55, G, J).................... 12

12. Size larger (♂, w. 4.8-5 mm.); femora with the tips insensibly darkened; wings broad with vein *2nd A* long, extending to about opposite midlength of petiole of cell M_1; male hypopygium (Fig. 55, G)................... **huron**
Size smaller (♂, w. 3.5-4.5 mm.); femora with the tips conspicuously black-

ened, broadest on fore legs; wings narrow, with vein *2nd A* short, extending to opposite *m-cu* or just beyond; male hypopygium (Fig. 55, J)...... **paludicola**

The following doubtful forms, both members of the *gracilis* group, are not included in the above key because of insufficient data.

Molophilus costopunctatus Dietz (Trans. Amer. Ent. Soc., 47:248; 1921). Mesonotum light brown, the pronotum and lateral pretergites light yellow. Head reddish brown; antennae relatively short; basal segments pale yellow, the outer segments light brown. Knobs of halteres fuscous. Wings tinged with yellow; a small but conspicuous costal spot between R_2 and tip of R_{1+2}. ♂. L. 2.3 mm.; w. 4 mm. Hazleton, Pa. (Sept.).

Molophilus forcipulus heterocerus Dietz. (*Ibid.*, 47:247-248; 1921). Differs from the typical form in the pale yellow antennal flagellum; scape brown; pedicel yellowish brown. The sulphur-yellow area on humeri scarcely evident. Hazleton, Pa. (Sept.).

Molophilus auricomus Alex. (Fig. 55, B).
1926. *Molophilus auricomus* Alexander; Insec. Inscit. Menst., 14:115-117.

Belongs to the *gracilis* group. General coloration reddish yellow. Antennae short in both sexes, the basal segments pale. Head yellow. Wings yellow, the costal region brighter, covered with yellow trichia. Male hypopygium (Fig. 55, B). ♂. L. about 3 mm.; w. 4 mm. ♀. L. about 3.5 mm.; w. 4.3 mm.

(June, July) N. C., S. C., Tenn.

M. cramptoni Alex. (Figs. 50, L; 55, C).
1924. *Molophilus cramptoni* Alexander; Bull. Brooklyn Ent. Soc., 19:61-62.

Belongs to the *plagiatus* group. General coloration dark brown; lateral pretergites restrictedly whitish. Antennae (♂) relatively long, if bent backward extending about to root of halteres; flagellar segments elongate-oval, clothed with long white setae. Halteres yellow. Wings (Fig. 50, L) strongly tinged with brown. Male hypopygium (Fig. 55, C). ♂. L. 4-4.2 mm.; w. 4.8 mm. ♀. L. 4.5-5 mm.; w. 4.8-5.4 mm.

(June) Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to S. C. and Tenn.

Connecticut.—Hartland, June 9, 1929 (C. P. A.).

M. forcipulus (O. S.) (Fig. 55, D).
1869. *Erioptera forcipula* Osten Sacken; Mon. Dipt. N. Amer., 4: 163-164.

Fig.—Dickinson, Cfls. Wisc., p. 196, fig. 80 (wing); 1932.

Belongs to the *gracilis* group. Mesonotum reddish brown, with a line of darker setae on praescutal interspaces; humeri and lateral pretergites pale yellow. Antennae with basal segments pale, the outer segments dark brown. Halteres infuscated, the apices of knobs a trifle brightened. Male hypopygium (Fig. 55, D). ♂. L. about 3-4 mm.; w. 3.5-5 mm.

(June, July) Ont., Que., N. B., Me., N. H., Vt., Mass., N. Y., N. J., westw. to Wisc., southw. to S. C., Tenn. and Fla.; chiefly in bogs.

Connecticut.—Putnam, June 15, 1933 (C. P. A.).

M. fultonensis Alex. (Fig. 55, E).
1916. *Molophilus fultonensis* Alexander: Proc. Acad. Nat. Sci. Philadelphia, 1916: 505-506.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 37 (wing), pl. 31, figs. 95, 96 (hyp.). Alexander, Cfls. N. Y., 1, pl. 34, fig. 67 (ven.); 1919.

Belongs to the *gracilis* group. Larger and darker colored than *pubipennis*. Antennae, especially of female, more elongate than in the corresponding sex of *pubipennis*. Thorax reddish brown, the pleura sometimes a little darker; abdomen dark brown, the hypopygium paler. Femora pale, the tips not or scarcely darker. Costal fringe of both sexes reddish brown to dark brown. Male hypopygium (Fig. 55, E). ♂. L. 4-4.5 mm.; w. 5-6.2 mm.; antenna about 3 mm. ♀. L. 4.5-5 mm.; w. 5.3-6 mm.

(June, July) Que., N. H., Mass., Ct., N. Y., westw. to Mich. and Wisc., southw. to S. C. and Tenn.

Connecticut.—Granby, June 8, 1929 (C. P. A.); Tunxis State Park, July 23, 1931 (C. P. A.).

M. hirtipennis (O. S.) (Fig. 55, F).
1859. *Erioptera hirtipennis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 228.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 22, fig. 6 (ven.); 1908. Alexander, Cfls. N. Y., 1, pl. 34, fig. 65 (ven.); 1919.

Belongs to the *plagiatus* group. General coloration dark brown, very sparsely pruinose; lateral pretergites restrictedly brightened. Antennae dark brown. Wings tinged with dusky, the costal region brighter; trichia dark-colored. Abdomen dark brown. Male hypopygium (Fig. 55, F). ♂. L. 3.5-4 mm.; w. 4-4.5 mm.

(June, July) Ont., Que., N. S., Me., N. H., Vt., Mass., N. Y., N. J., Pa., westw. to Ind. and Ill., southw. to N. C. and Tenn.

Connecticut.—East River, July 1910 (Ely); Hartland, June 8, 1929 (C. P. A.); Kent Falls, June 12-13, 1931 (C. P. A.); Manitic Lake, June 8-9, 1929 (C. P. A.); Norfolk, June 9, 1929 (C. P. A.).

Rogers (1942) believes that this species as well as *M. pubipennis* O. S. and *M. soror* Alex. are chiefly or entirely parthenogenetic.

M. huron Alex. (Fig. 55, G).
1929. *Molophilus huron* Alexander: Journ. N. Y. Ent. Soc., 37: 56-57.

Belongs to the *gracilis* group; most closely allied to *fultonensis* and *paludicola*. From *paludicola* it differs in the larger size, somewhat broader wings, with more elongate vein *2nd A*, and in the indistinctly darkened tips of the femora. From *fultonensis* it differs especially in the structure of the male hypopygium (Fig. 55, G), notably the short peg-like spines of the mesal lobe of the basistyle and

FIGURE 55. Eriopterini; male hypopygia.

A. *Tasiocera (Dasymolophilus) ursina* (O. S.)

B. *Molophilus auricomus* Alex.

C. *M. cramptoni* Alex.

D. *M. forcipulus* (O. S.)

E. *M. fultonensis* Alex.

F. *M. hirtipennis* (O. S.)

G. *M. huron* Alex.

H. *M. laricicola* Alex.

I. *M. nova-caesariensis* Alex.

J. *M. paludicola* Alex.

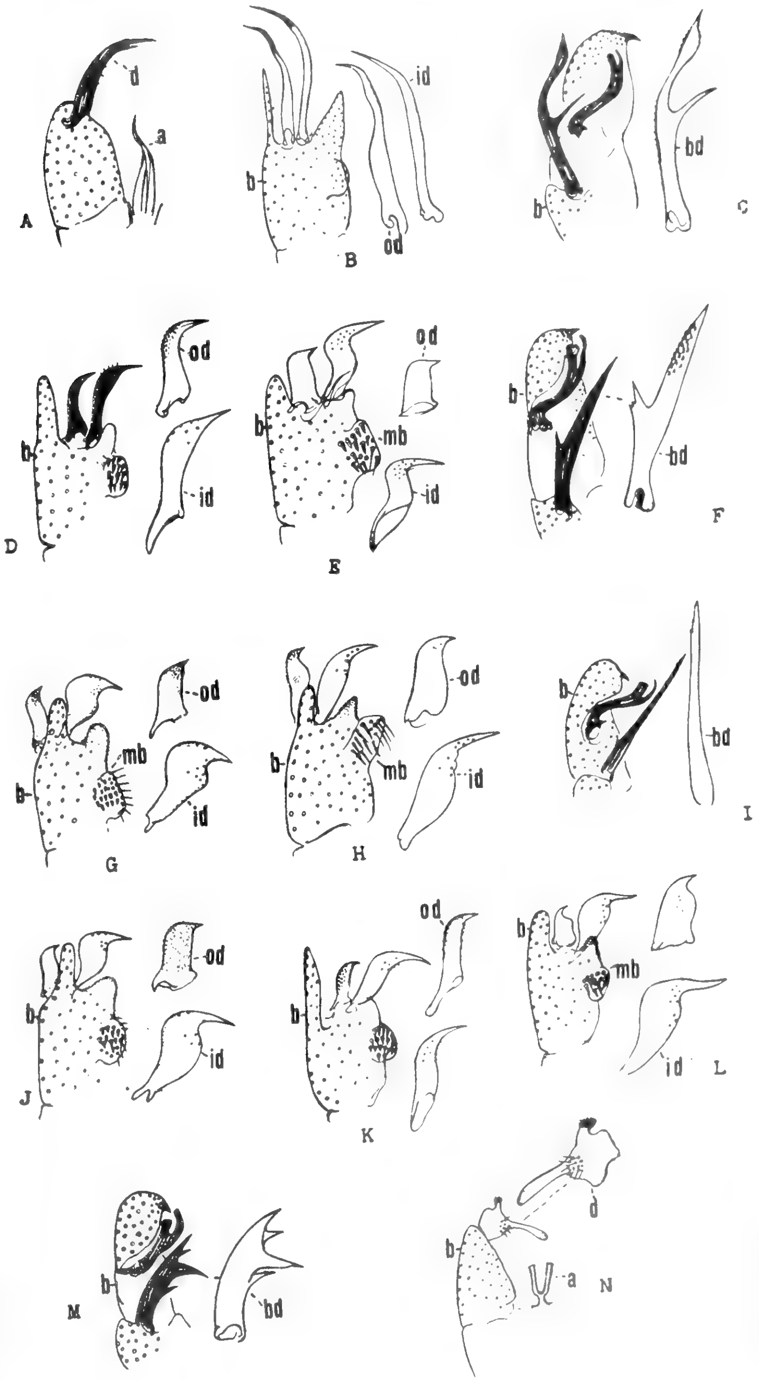
K. *M. pollex* Alex.

L. *M. pubipennis* (O. S.)

M. *M. quadrispinosus* Alex.

N. *Toxorhina (Toxorhina) mulicbris* (O. S.)

Symbols: *a*, aedeagus; *b*, basistyle; *bd*, basal dististyle; *d*, dististyle; *id*, inner dististyle; *mb*, median lobe of basistyle; *od*, outer dististyle.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the broader inner dististyle. ♂. L. about 4-4.2 mm.; w. 4.8-5 mm.; antenna, about 2.8-3 mm. ♀. L. about 5 mm.; w. 5.5 mm.

(July, Aug.) Mich.

M. laricicola Alex. (Fig. 55, H).
1929. *Molophilus laricicola* Alexander; Journ. N. Y. Ent. Soc., 37: 55-56.

Belongs to the *gracilis* group. General coloration reddish brown. Male hypopygium (Fig. 55, H) with the dorsal lobe shorter than in *pollex*. ♂. L. about 4 mm.; w. 5-5.2 mm.; antenna, about 2 mm. ♀. L. about 4.5-5 mm.; w. 5.5-6 mm.

(June) Me., N. H., Vt., N. Y.; in sphagnum bogs.

This species and *M. pollex* are readily told from all other members of the *gracilis* group by the intermediate length of the male antennae.

M. nova-caesariensis Alex. (Fig. 55, I).
1916. *Molophilus nova-caesariensis* Alexander; Proc. Acad. Nat. Sci. Philadelphia, 1916: 506-507.

Figs.—Alexander, *Ibid.*, pl. 27, fig. 38 (ven.). Alexander, Cfls. N. Y., 1, pl. 34, fig. 68 (ven.); 1919. Dickinson, Cfls. Wisc., p. 194, fig. 79 (wing); 1932.

Belongs to the *plagiatus* group. General coloration very dark brown or black, heavily gray pruinose; lateral pretergites restrictedly light yellow. Antennae of moderate length, somewhat shorter than in *cramptoni* but longer than in *hirtipennis*. Legs chiefly black, the femoral bases yellow. Wings with *m-cu* at or shortly beyond the fork of *M*. Male hypopygium (Fig. 55, I). ♂. L. 2.7-3 mm.; w. 2.8-3.5 mm. ♀. L. 3-3.5 mm.; w. 3-3.5 mm.

(Apr., May) N. J., Ind., Va., westw. to Wisc., southw. to Fla.

(Transition, Austral).

M. paludicola Alex. (Fig. 55, J).
1929. *Molophilus paludicola* Alexander; Journ. N. Y. Ent. Soc., 37: 57-58.

Belongs to the *gracilis* group, most nearly allied to *huron*. General coloration of mesonotum reddish gray to dark brown, the lateral pretergites pale yellow. Abdomen black, the hypopygium brightened. Male hypopygium (Fig. 55, J). ♂. L. 3-4 mm.; w. 3.5-4.5 mm. ♀. L. 4.5-5 mm.; w. 4.8-5 mm.

(June-Aug.) Me., Vt., Mass., Ct.; in boggy woods and meadows.

Connecticut.—Brooklyn, June 15, 1933 (C. P. A.); Hamden, June 30, 1932 (N. T.), July 8-13, 1932 (P. G.); Putnam, June 15, 1933 (C. P. A.); Stafford Springs, June 14, 1933 (C. P. A.).

M. pollex Alex. (Fig. 55, K).
1931. *Molophilus pollex* Alexander; Can. Ent., 63: 146-147.

Belongs to the *gracilis* group; most nearly allied to *laricicola*. General coloration light brown. Antennae (♂) black throughout.

Wings yellowish gray, the axillary region more infumed; vein *2nd A* ending some distance before *m-cu*. Male hypopygium (Fig. 55, K). ♂. L. about 3.8 mm.; w. 3.5 mm.; antenna, about 1.8 mm.

(June) Que., N. B.

M. pubipennis (O. S.) (Fig. 55, L).

1859. *Erioptera pubipennis* Osten Sacken: Proc. Acad. Nat. Sci. Philadelphia, 1859: 228.

Figs.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 66 (ven.); 1919. Crampton, Insec. Inscit. Menst., 13, pl. 2, fig. 4; pl. 3, fig. 17 (thorax); 1925.

Belongs to the *gracilis* group. General coloration pale reddish yellow. Head yellow. Knobs of halteres weakly darkened (♂) or clear yellow (♀). In female, costal border of wings densely clothed with golden-yellow trichia; in male, these trichia more brownish yellow to pale brown. Male hypopygium (Fig. 55, L) with the outer dististyle almost glabrous.

The female is well-distinguished by the golden-yellow costal trichia but the males have not yet been satisfactorily separated. In what appears to represent a single species, a rather remarkable range in the amount and coarseness of the setae of the outer dististyle is found. ♂. L. about 3.5-4 mm.; w. 4-4.5 mm.; antennae, about 2.25 mm. ♀. L. 3.5-4 mm.; w. 4-4.5 mm.

It is doubtful that the male associated with this species belongs here. See note under *M. hirtipennis*.

(June-Aug.) Ont., Que., Me., N. H., Vt., Mass., N. Y., westw. to Ind. and Mich., southw. to S. C., Ga., Tenn. and Fla.

Connecticut.—Bloomfield, Aug. 6, 1929 (C. P. A.); Cornwall Bridge, June 12-13, 1931 (C. P. A.); Kent Falls, June 12-13, 1931, July 23-24, 1931, Aug. 19, 1931 (C. P. A.); Norfolk, May 31, 1931, June 12, 1931, July 24, 1931 (C. P. A.); Riverton, June 8, 1929 (C. P. A.); Saptree Run State Park, June 14, 1933 (C. P. A.); Twin Lakes, Sept. 12, 1928 (C. P. A.); Tyler Lake, June 13, 1931, July 23, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

M. quadrispinosus Alex. (Fig. 55, M).

1924. *Molophilus quadrispinosus* Alexander: Bull. Brooklyn Ent. Soc., 19: 62.

Belongs to the *plagiatus* group. General coloration dark grayish brown, the humeral region of praescutum more brownish yellow. Halteres light yellow. Male hypopygium (Fig. 55, M). ♂. L. about 3.5-4 mm.; w. 4.5-5 mm.

(Late May, June) Que., N. B., Vt., Mass., Ct., N. Y., westw. to Mich.

Connecticut.—Kent Falls, May 30-31, 1931 (C. P. A.); Riverton, May 30, 1931 (C. P. A.); W. Granby, June 8, 1929 (C. P. A.).

M. soror Alex.

1927. *Molophilus soror* Alexander: Occas. Pap. Boston Soc. Nat. Hist., 5: 230-231.

Fig.—Alexander, Cfls. N. Y., 1, pl. 34, fig. 69 (ven.); 1919 (as *comatus* Doane).

Belongs to the *gracilis* group. General coloration brownish gray. Antennae short, brownish black. Halteres pale. Wings whitish, the

base and costal border strongly yellowish; a narrow brown seam along veins *Cu*, *m-cu* and basal section of M_{3+4}. ♀. L. 4-5 mm.; w. 5-6 mm.

The male sex has not been discovered. See note under *M. hirtipennis*.

(Aug., Sept.) N. B., Me., westw. to Mich. and Alta.

4. Subtribe TOXORHINARIA

Toxorhina Loew

1851. *Toxorhina* Loew; Linnaea Entomol., 5: 400.
1869. *Toxorrhina* Osten Sacken; Mon. Dipt. N. Amer., 4: 109-114.

A moderate-sized group of very peculiar and isolated crane-flies, readily told by the reduced radial venation (Fig. 50, M), the elongate rostrum with mouth parts at extreme tip, and the profoundly bifid setae on legs. Other peculiar features lie in the uniting of certain of the basal flagellar segments into a conical "fusion-segment", the presence of very long setae on the outer flagellar segments, and the greatly lengthened cervical region, with the anterior portion of the praescutum produced cephalad over its base. The resemblance to *Elephantomyia* appears to be merely superficial. The adult flies of our northern species, *muliebris*, may be swept from vegetation in boggy areas. The early stages remain undiscovered.

Key to Species

1. Cell *1st* M_2 closed; body-coloration brownish yellow to brown; average size large (♂, L. 7 mm. or more) .... **magna**
   Cell *1st* M_2 open by the atrophy of *m*, closed only in abnormal specimens (Fig. 50, M); body-coloration gray to brownish gray; average size smaller (♂, L. 6 mm. or less) .... **muliebris**

Toxorhina (*Toxorhina*) **magna** (O. S.)

1865. *Toxorrhina magna* Osten Sacken; Proc. Philadelphia Ent. Soc., 4: 232.

Figs.—Osten Sacken, Mon. Dipt. N. Amer., 4, pl. 1, fig. 6 (wing); 1869. Alexander, Cfls. N. Y., 1, pl. 33, fig. 45 (ven.); 1919.

Postnotum and pleura more pruinose than notum. Legs chiefly brown; tips of tibiae narrowly dark brown or black. Abdomen elongate, the segments pale brown, with darker brown incisures. ♂. L., excluding rostrum, 7-10 mm.; w. 5.5-7.5 mm.; rostrum, 3-3.5 mm. ♀. L., excluding rostrum, 9-12 mm.; w. 5.5-8 mm.; rostrum, 3.5-4.5 mm.

(Apr.-July; Sept.-Oct.) Mass. (Nantucket Is.); N. J., westw. to Mich.; southw. to S. C., Ga., Fla. and La. (Austral, Transition).

T. (*Toxorhina*) **muliebris** (O. S.) (Figs. 50, M; 55, N).

1865. *Toxorrhina muliebris* Osten Sacken; Proc. Philadelphia Ent. Soc., 4: 233.

Figs.—Needham, 23rd Rept. N. Y. St. Ent. for 1907, pl. 29, fig. 5 (ven.); 1908.

Alexander, Cfls. N. Y., 1, pl. 33, fig. 46 (ven.); 1919. Dickinson, Cfls. Wisc., p. 199, fig. 88 (wing); 1932.

Legs yellow to brownish yellow; terminal segments darker. Abdomen uniformly dark brown; hypopygium paler brown. Male hypopygium (Fig. 55, N). ♂. L., excluding rostrum, 5.5-6 mm.; w. 4.5-5 mm.; rostrum, 2-2.5 mm. ♀. L., excluding rostrum, 6-7 mm.; w. 5-5.5 mm.; rostrum, 2-2.5 mm.

(Mid-June-early Aug.) Que., Me., Vt., Mass., R. I., Ct., N. Y., Pa., westw. to Ind., Ill., Mich. and Wisc., southw. to Md. and Va. (Canadian, Transition).

Connecticut.—East River, July 10, 1910 (Ely).

Addenda

The manuscript on the Tipulidae was completed some years ago but for various reasons the actual publication has been delayed to the present moment. In the intervening years an attempt has been made to keep up to date the general records of distribution of the various species discussed throughout the report. During this period a certain number of additional new species have been described from the region under consideration. It does not seem advisable to revise the keys to accommodate these forms but it is believed that a listing of the species will prove helpful to advanced students of the family. Three of these species (*Pedicia procteriana* Alexander, *Phyllolabis lagganensis* Alexander and *Dactylolabis pemetica* Alexander) are of such importance and interest that a brief statement concerning each has been interpolated in the text at the proper place. The further species described since the completion of the manuscript are as follows:

Dolichopeza (*Oropeza*) **pratti** Alexander: Ent. News, 52: 192-193; 1941 (Minn.)

Tipula (*Yamatotipula*) **succincta** Alexander: Can. Ent., 72: 151-152; 1940 (Ind.)

Tipula (*Oreomyza*) **broweri** Alexander: Ent. News, 51: 83-85; 1940 (Me.)

Limonia (*Limonia*) **pemetica** Alexander: Bull. Brooklyn Ent. Soc., 34: 95-97; 1939 (Me.)

Limonia (*Dicranomyia*) **broweriana** Alexander: Ent. News, 52: 193-195; 1941 (Me.)

Limonia (*Dicranomyia*) **piscataquis** Alexander: Can. Ent., 73: 86-87; 1941 (Me.)

Limonia (*Rhipidia*) **gaspicola** Alexander: *Ibid.*, 73: 87-88; 1941 (Que.: Gaspé)

Antocha (*Antocha*) **biarmata** Alexander: Amer. Midl. Nat., 24: 620-621; 1940 (N. Y.)

Pedicia (*Tricyphona*) **auripennis breviclava** Alexander: *Ibid.*, 26: 299; 1941 (Que.: Gaspé)

Dicranota (*Dicranota*) **fumipennis** Alexander: Can. Ent., 73: 89; 1941 (Minn.)

Limnophila (*Idioptera*) **mcclureana** Alexander: Bull. Brooklyn Ent. Soc., 33: 75-76; 1938 (Man.)

Pilaria harrisoni Alexander; Occas. Pap. Boston Soc. Nat. Hist., 8: 291-292; 1936 (N. H.)
Chionea stoneana Alexander; Ent. News, 51: 100-102; 1940 (Ill.)
Rhabdomastix (*Sacandaga*) **hansoni** Alexander; Bull. Brooklyn Ent. Soc., 34: 99-100; 1939 (Mass.)
Erioptera (*Erioptera*) **chlorophylloides orthomera** Alexander; Can. Ent., 72: 155; 1940 (Ct.)
Erioptera (*Erioptera*) **leptostyla** Alexander; *Ibid.*, 72: 154-155; 1940 (Mich.)
Erioptera (*Mesocyphona*) **serpentina** Alexander; Amer. Midl. Nat., 26: 318; 1941 (Mass.)
Erioptera (*Psiloconopa*) **churchillensis** Alexander; Bull. Brooklyn Ent. Soc., 33: 77-78; 1938 (Man.)
Erioptera (*Psiloconopa*) **lacustris** Alexander; *Ibid.*, 33: 76-77; 1938 (Mich.)
Ormosia (*Ormosia*) **broweri** Alexander; *Ibid.*, 34: 100; 1939 (Me.)

Index

Part I - Morphology

Part II - Taxonomy

Plate I.

Diptera

1. *Nephrotoma ferruginea* Fabr. (Tipulidae). x 1
2. *Bibio albipennis* Say (Bibionidae), male, female, and larva. x 4
3. *Asilus sericeus* Say (Asilidae). x 2
4. Bulb fly, *Merodon equestris* Fabr. (Syrphidae). x 2
5. *Microdon tristis* Loew (Syrphidae). x 1
6. Apple maggot fly, *Rhagoletis pomonella* Walsh (Trupaneidae). x 2

PLATE I

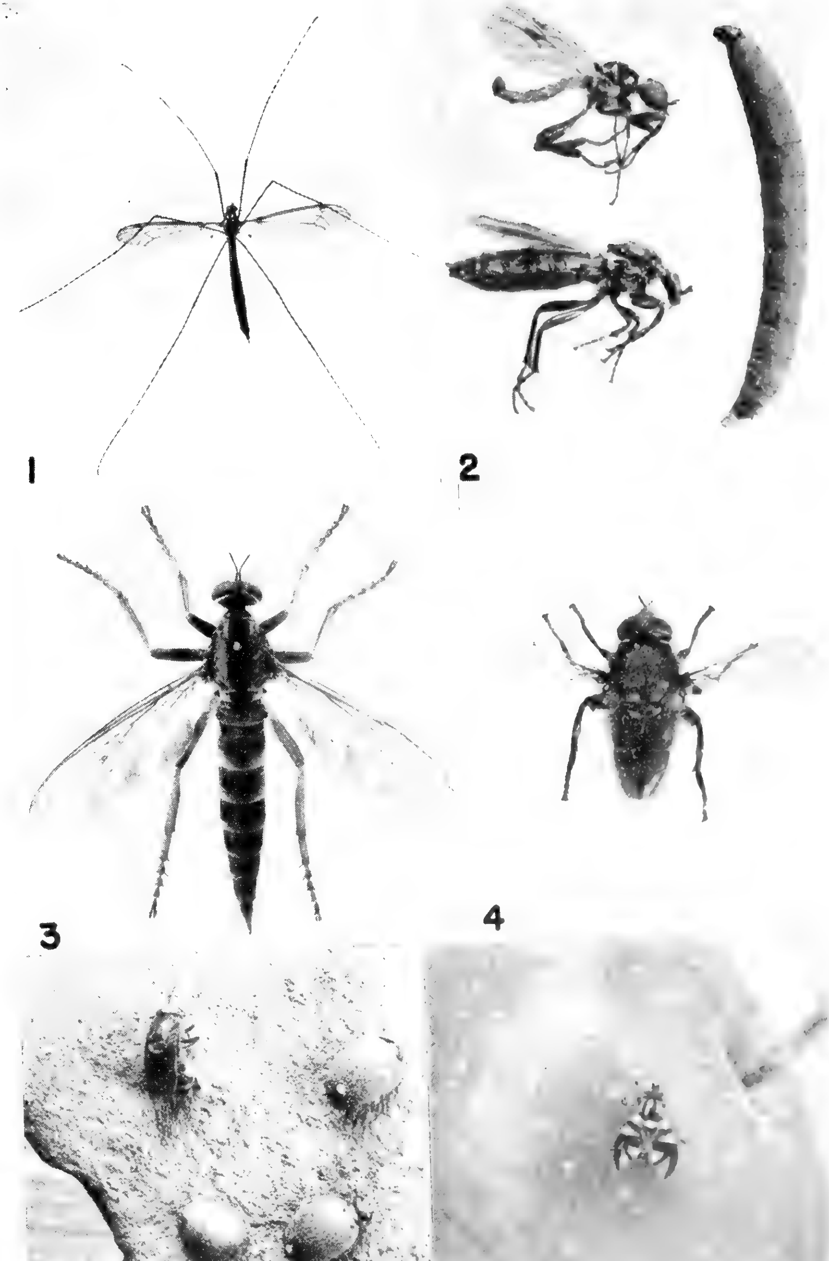


Plate II.

Diptera

1. Housefly, *Musca domestica* Linn. (Muscidae). x 5
2. Parasitic fly, *Tachina mella* Walk. (Tachinidae). x 2
3. Parasitic fly, *Winthemia quadripustulata* Fabr. (Tachinidae). x 2
4. Stable fly, *Muscina stabulans* Fall. (Muscidae). x 2
5. Cabbage maggot, *Phorbia brassicae* Bouché (Muscidae). x 2
6. Green bottle fly, *Lucilia sericata* Meigen (Metopiidae). x 1. Killed by fungus, on magnolia leaf.

PLATE II

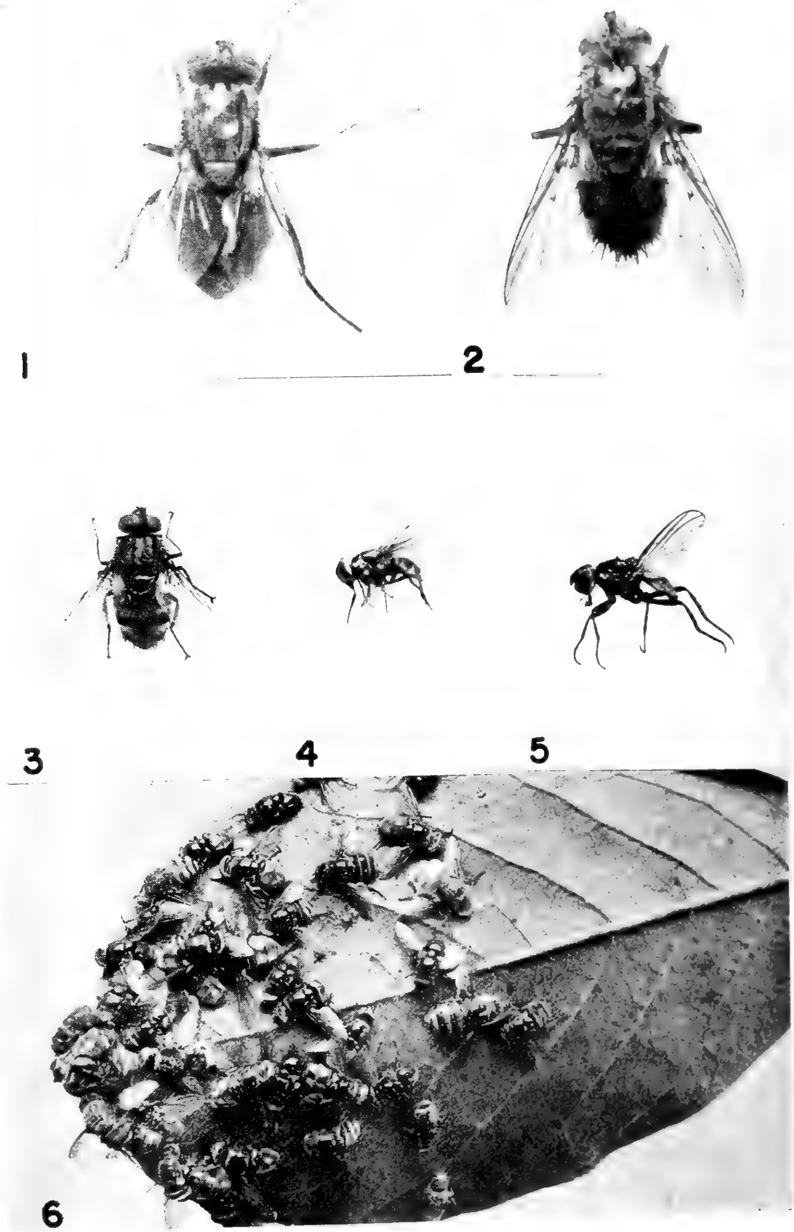


Plate III.

Gall-forming Diptera

1. *Cecidomyia ocellaris* O. S. (Cecidomyidae). Galls on red maple.

2. Honey locust pod gall, *Dasyneura gleditschiae* O. S. (Cecidomyidae), on honey locust.

3. Pine cone gall, *Rhabdophaga strobiloides* Walsh (Cécidomyidae), on willow.

4. Ash midrib gall, *Contarinia canadensis* Felt (Cecidomyidae), on ash.

5. Goldenrod ball gall, *Eurosta solidaginis* Fitch (Trupaneidae), on goldenrod.

6. Wheat ear gall, *Rhabdophaga triticoides* Walsh (Cecidomyidae), on willow.

All natural size.

PLATE III

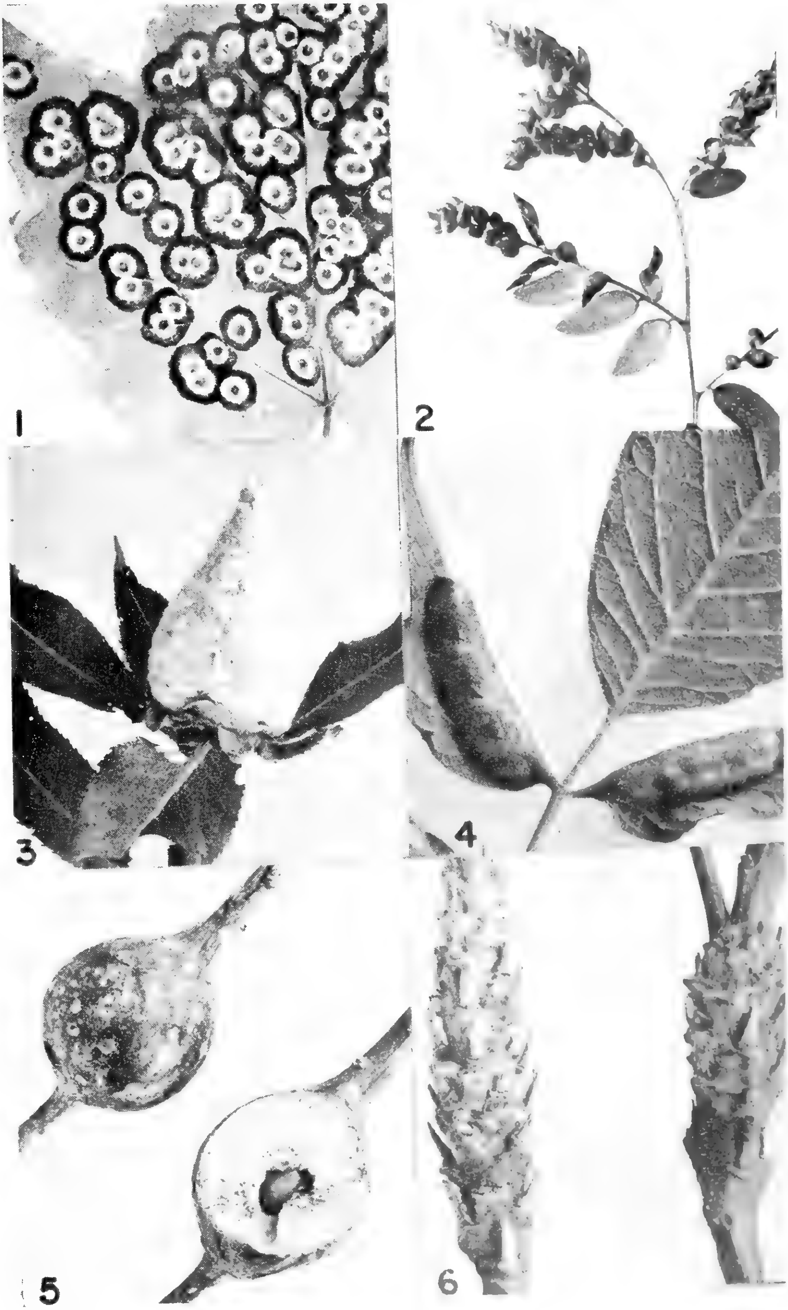


Plate IV.

Injury to plants by Diptera

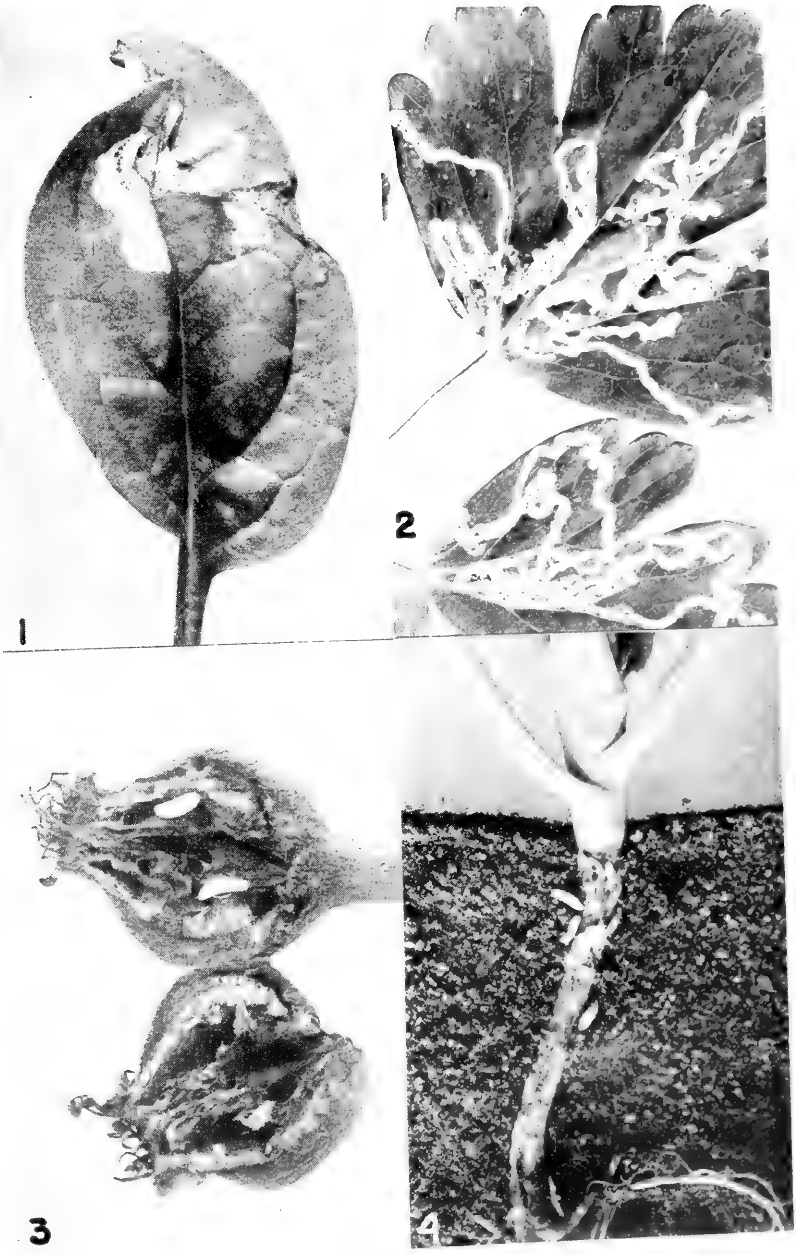
1. Blotch mines of the spinach leaf miner, *Pegomyia hyoscyami* Panz. (Muscidae). x 1

2. Serpentine mine of the columbine leaf miner, *Phytomyza aquilegiae* Hardy (Agromyzidae). x 1

3. Larvae of pear midge, *Contarinia pyrivora* Riley (Cecidomyidae), in young pears. x 2

4. Larvae of the cabbage maggot, *Hylemyia brassicae* Bouché (Muscidae), injuring cabbage plant. x 1

PLATE IV



State

Geological and Natural History Survey

of

Connecticut

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48. Additions to the Flora of Connecticut (Supplement to Bull. No. 14): by E. B. Harger, C. B. Graves, M.D., E. H. Eames, M.D., C. A. Weatherby, A.M., R. W. Woodward, and G. H. Bartlett; 94 pp., 23 cm., 1930. .75

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63. Supplement. Some 60 maps showing bottom contours of important Connecticut lakes; scale 1″ to 600′. These may be secured singly for .25
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64. The Diptera or True Flies of Connecticut: by G. C. Crampton, Ph.D., Morphology; C. H. Curran, D.Sc., Key to Families; C. P. Alexander, Ph.D., Tanyderidae, Ptychopteridae, Trichoceridae, Anisopodidae, Tipulidae; 509 pp., 56 figs., 4 pls., 23 cm., 1942.